# Eye Health

## A Teaching Handbook for Nurses

The National Society for the
Prevention of Blindness, Inc.
1790 Broadway, New York 19, N. Y.

Publication 447

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AMERICAN FOUNDATION
FOR THE BLIND INC.

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## Foreword and Acknowledgments

THROUGHOUT its history of almost forty years, the National Society for the Prevention of Blindness has recognized the place of the nurse in sight conservation. Founded in 1908 as a New York State Committee, it expanded in 1915 to a national agency—broadening its program from the battle against ophthalmia neonatorum to a war against all causes of blindness and impaired vision. As early as twenty years ago, the Society added to its staff a public health nurse, and has since retained an associate for nursing activities through whose program its services have been made available to all fields of nursing.

The National Society for the Prevention of Blindness dedicates this volume to those for whom it is prepared: to nurses—whether they be private duty, institutional or public health nurses—in school, clinic, industry, home or hospital. It is designed to provide the nursing profession with background information on positive aspects of eye health. It comes in response to an overwhelming demand by nurses for basic information on normal eyes, their functioning and development, on measures to assure eye health and protection, and on the part nurses can play in teaching eye health.

While methods of preventing blindness are brought out in this volume, the agencies through which such activities are carried vary too much from community to community to be described in the limited space available.* Suffice it to say that, in addition to a number of state prevention of blindness agencies, many local health, welfare and safety departments include activities bearing on conservation of vision, and the Society, in so far as possible, acts as a liaison and advisory agency.

In preparation of this handbook, the services of Miss Anna C. Gring, R.N., formerly of the American Red Cross, were enlisted to collaborate with the Society's recent associate for nursing activities, Miss Eleanor W. Mumford, R.N. Also assisting in its preparation were the following nurses who have been members of the Society's Nursing Advisory Committee: Marguerite Wales, R.N.; Mary J. Dunn, R.N.; Mary B. Hulsizer, R.N.; Sallie Jeffries, R.N.; Joanna M. Johnson, R.N.; Josephine McLeod, R.N.; Cora L. Shaw, R.N.; Ruth Sleeper, R.N.; and Ruth Taylor, R.N.; as well as several members of the Society's staff.

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* The National Society for the Prevention of Blindness will be glad to provide, upon request, what information it has available on local resources and agencies carrying some aspect of sight conservation work.

The Society also acknowledges with gratitude the valuable assistance of Walter B. Lancaster, M.D., Thomas H. Johnson, M.D., Arnold Gesell, M.D., and Gertrude Driscoll, Ph.D., who reviewed the manuscript and suggested revisions.

—ELEANOR BROWN MERRILL, Executive Director

## Table of Contents

CHAPTER PAGE

I. INTRODUCTION . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 7

II. THE ORGANS OF SIGHT . . . . . . . . . . . . . . . . . . . . . . . . . 9
Eye Health and General Health; Tissues Surrounding the Eyes; The Eyes.

III. THE SEEING PROCESS . . . . . . . . . . . . . . . . . . . . . . . . 20
The Refractive System of the Eyes; Errors of Refraction; Binocular Single Vision; Color Vision.

IV. MAKING THE BEST USE OF THE EYES . . . . . . . . . . . . . . . 28
Light and the Eyes; Lighting and Room Arrangements.

V. "SCREENING," EYE EXAMINATIONS, AND FOLLOW-UP . . 37
Screening for Eye Difficulties; Description of Screening Tests; Eye Examinations; Long-Term Follow-Up.

VI. CAUSES OF DEFECTIVE VISION AND BLINDNESS . . . . . . . 51
Definitions of Blindness, Defective Vision, and Partial Sight; Extent and Causes of Blindness; Amount and Causes of Defective Vision.

VII. THE EYES IN CHILDHOOD . . . . . . . . . . . . . . . . . . . . . . . 55
Heredity and the Eyes; The Eyes in the Prenatal Period; The Eyes in Infancy; Vision of the Preschool Child; Eye Health of the School Child; Vision and Eye Health of High School Students; Responsibilities of Adults for the Eye Health of Children.

VIII. EYE HEALTH PROBLEMS IN ADULT LIFE . . . . . . . . . . . . . 80
Vision and Activities of Adults; Industrial Eye Programs; Common Eye Difficulties in Adult Life.

IX. EYE SAFETY, FIRST AID, AND FOLLOW-UP FOR EYE INJURIES . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 87
Nursing Procedures for Eye Emergencies.

CHAPTER PAGE
X. OPPORTUNITIES FOR THE NURSE TO TEACH EYE HEALTH 94
Exhibits and Demonstrations; Projects for Special Groups.

REFERENCES.......................................... 101

INDEX.............................................. 104

# Chapter I.—Introduction

MODERN living subjects the human eye to many strains and hazards unknown to primitive man. To meet new conditions an active program for sight conservation is necessary. This calls for the co-operation of many groups and individuals. The rôle of the nurse in such a program includes activities for the care and protection of sight in health and sickness, teaching and guiding people as to the best means of caring for eyes, and co-operating in community efforts for conserving sight. She shares with the doctor the responsibility for care of the eyes of the newborn, thus helping to prevent infection and possible loss of sight. She gives skilled nursing care in eye diseases and injuries, and should have a sense of responsibility for the visual comfort and the eyes of all her patients as well as of the healthy individuals with whom she is in contact.

She has opportunities to teach mothers to take care of the eyes of infants and children and to recognize signs of abnormality. In well-child conferences, schools and in industry she is often called upon to give screening tests to aid in the discovery of those needing eye care. Persons of all ages frequently seek a nurse's advice about major or minor eye problems. The patient who drifts from one doctor to another, trying to find a quick or easy cure for crossed-eyes, cataract, glaucoma or some other serious eye condition, often comes to her attention. Thus, the nurse has occasion to come into contact with many who need treatment for eye conditions, to encourage them to seek it early, and to guide them to proper sources.

A nurse's opportunities for teaching the care of eyes are limited largely by her knowledge of the subject and her ability to teach. Much of her teaching is of an informal nature, occasioned by her contact with individuals. However, she is concerned not only with guiding those with eye difficulties, but with the even more important function of actively promoting eye health. She is interested in helping to secure safe and favorable working conditions for everyone, assisting in accident prevention, adjustment of lighting, and analysis of the nature of visual tasks coming within her scope.

The importance of knowledge of how sight can be protected and preserved is indisputable; the problem is to learn the aspects of the subject in which the group is most interested, and to present the material so as to give the greatest benefit. Many people want information which will help them to understand their own or their families' eye difficulties. Parents and teachers are naturally interested in children's eyes. They need to know what the state of eye development is at various ages; the relation of eyes to school and play activities; how to prevent an injury or infection; and how to plan for the child with limited sight. Housewives often have problems on home lighting or eye protection in the home. Employers, industrial supervisors, and workers are quick to recognize the importance of good sight in industry and want information on how it can best be utilized and protected. Many persons wearing or needing glasses want to know more about their proper care and use. Those who have the responsibility for persons with limited sight want information about education, recreation, rehabilitation, and placement. They want to understand what the eye difficulty means to the individual and how they can best help. Mothers often want to know how to carry out the doctor's orders for eye treatments. Opportunity for teaching the dangers of self-treatment should not be overlooked.

For such duties, the nurse needs a broad knowledge of the subject and many types of skills. She must know how eyes develop and function, factors which affect sight, and signs of abnormality; and she must be familiar with community resources for eye care. She must understand the psychological and social implications of visual disabilities for the individual and for those around him. She must be skillful in interpreting scientific information to patients and to co-workers with various backgrounds. She must have ingenuity in improvising various types of facilities in homes, schools, and industries. Above all, she must be a good teamworker, and recognize her rôle in relation to that of other workers.

# Chapter II.—The Organs of Sight

## Eye Health and General Health

General health has a great influence on the health of the eyes; conversely, the condition and functioning of the eyes affect the whole person physically, psychologically and socially.

All that favors and promotes general health helps to keep the eyes in a healthy condition and enables them to function at their maximum. While the eyes are a part of the nervous system, they are affected also by other systems, especially the circulatory, digestive and glandular. They are so sensitive to changes in these that ocular disturbances often provide early clues to systemic conditions.

Familiar systemic effects of eye difficulties are headache, loss of appetite, nausea and dizziness. Some conditions tend to lead to poor posture with all of its attendant ill effects. Some limit physical activity. Eye infections may affect the general health; difficulties originating in the eyes may spread to neighboring tissues.

The psychological aspects of eye health are equally important. Fear of loss of sight brings a great sense of insecurity, as does fear of disfigurement from eye surgery, disease or injury. Reactions to eye conditions are apt to be severe, but while some eye diseases or defects are prone to produce more or less characteristic reactions, there are wide individual differences in how people feel and what they do in any given situation. Some will seek and follow proper advice as soon as a difficulty is suspected, while others will neglect treatment even when the seriousness is obvious. Reactions may be quite out of proportion to the severity, some exaggerating, others minimizing, the condition. Defective vision may handicap one individual and serve as a challenge to another.

Understanding the psychological reactions is an important step in assisting an individual in meeting an eye problem. Some are based on ignorance, misinformation and superstition, others on fear, pride or other emotions. Often, the attitude of the patient toward an eye condition is influenced by those about him, or, what is quite as important, how he interprets their attitudes.

**Nutrition.**—The eyes are composed of many types of tissue—muscles, nerves, blood vessels and others—all requiring nutrition. Hence, a balanced and adequate diet is as essential to healthy eyes as to the health of the rest of the body. While extensive research concerning nutrition in relation to the eyes has been going on for some time, much of the information is still in the laboratory stage and cannot yet be widely applied to preventing unfavorable eye conditions. However, deficiencies of diet are known to produce various ocular difficulties or lesions of varying degrees of severity, and diet therapy is being used increasingly in ophthalmological treatment.

Although they may not be specific for the prevention of ocular diseases, vitamins influence the health of the eye, and vitamin therapy frequently helps in overcoming some eye difficulties. It is known, for example, that an adequate intake of vitamin A and its effective utilization are essential to the nutrition of such structures as the cornea, as well as for efficient adaptation to darkness and light. (See **Visual Purple,** p. 16.) Therefore, vitamin A is used, often in connection with other vitamins, in treating numerous diseases of the eye, especially those affecting the epithelial tissues of the eyes and lids. The various factors in the vitamin B complex have proven useful for treatment of some conditions of the cornea, retina and optic nerve. Lack of the vitamin riboflavin predisposes to corneal disease and ulcers, which may result in considerable loss of vision. While, experimentally, a diet deficient in riboflavin has been known to lead to cataract in animals, there is no evidence that cataract in humans can be prevented by the administration of vitamin G. Similarly, it is thought that vitamin C has some part to play in the metabolism of the normal lens. Vitamins C and K are sometimes used in the treatment of pathological conditions of the capillaries of the eyes. Vitamin D and calcium have also been used in the treatment of certain ocular conditions.

## Tissues Surrounding the Eyes*

The eye rests on a cushion of fat and is set in a funnel-shaped cavity formed by the bony structure called the orbit. Between the pad of fat and the eyeball is a serous sac which partially envelops the eyeball. The orbit forms a socket in which the eye rotates. At the inner end or apex of each orbit is a short circular canal through which pass the optic nerve and the ophthalmic artery, a branch of the internal carotid (the principal artery of the neck). The eyebrows help to shade the eyes and keep perspiration from entering them. The eyelids, which consist of movable folds of skin and loose connective and fibrous tissues, protect the eyes from external injuries, foreign bodies, undue exposure, excessive light, and from drying.

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* Kimber, Diana Clifford; Gray, Carolyn E.; and Stackpole, Caroline E. *Textbook of Anatomy and Physiology.* Macmillan Co., New York, 11th ed., 1942.

The lacrimal glands, which secrete the tears, are located on the temporal side in the orbits of the eyeballs. Ducts leading from these glands carry the tears to the surface of the eyeballs. Through blinking, the lids spread the tears over the eyeballs, forcing any excess to the lacrimal sacs at the inner angle of the eyes. Thence they drain into the nose through the nasolacrimal ducts. The function of the tears is to keep the surface of the eyes moist and to help wash away foreign bodies and microorganisms. Tears have a slightly antiseptic quality.

Eyelashes rise from the margins of the lids. The follicles of the eyelashes receive lubricating fluid from the sebaceous glands which open into them. On the edge of the eyelids, just inside the line of the lashes, are the openings of a row of glands called the Meibomian glands. These secrete an oily fluid which tends to prevent the overflow of tears and possible adhesions of the eyelids.

**The Extrinsic Muscles.**—Each eyeball is moved in its socket by six muscles attached to the outside of the eye. These are called extrinsic muscles. Four of these, arising from a common point at the apex of the orbit, diverge to form a cone surrounding the posterior part of the globe and the optic nerve. One is attached to the top of the eyeball, one to the bottom, and the others to the two sides. Their function is to turn the eye up, down, and to either side. Another muscle also originates from the apex of the orbit, passes forward through a pulley at the anterior rim of the orbit, where it turns back and is inserted in the posterior side of the outer coating of the eye. The sixth muscle comes from the anterior wall of the cavity and passes backward around the eye to be inserted in the upper posterior part of the outer covering. The function of these two muscles is to turn the eyes in oblique positions—up-and-in, up-and-out, down-and-in, and down-and-out. In every movement of the eyes all the muscles act together—some expand while others contract. If all are working in harmony, the eyes rotate freely in their orbits and in co-ordination with each other.

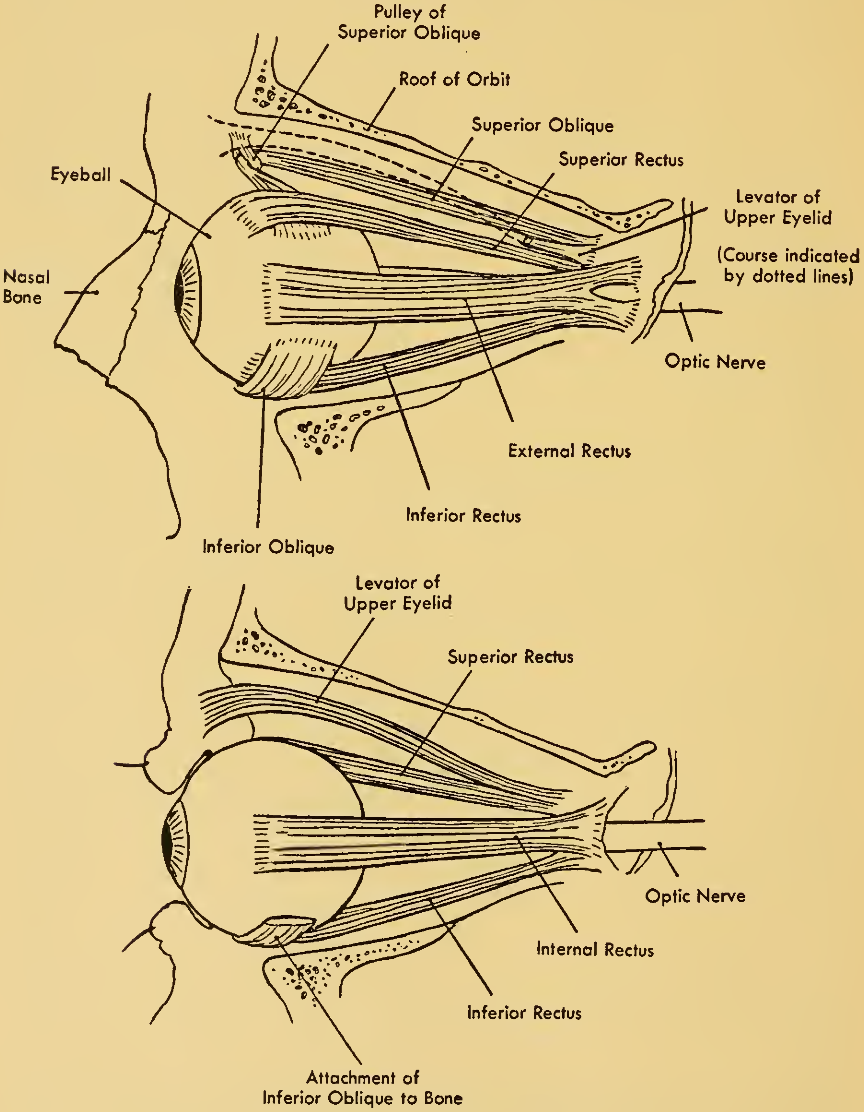

Fig. 1.—External Muscles of the Eye

**Conjunctiva.**—A sensitive mucous membrane called the conjunctiva lines the eyelids and extends over the anterior surface of the eyeball to the edge of the cornea. It is also continuous with the lining of the lacrimal sac, nasolacrimal duct and nose.

## The Eyes

The eyes are approximately spherical and, in the adult, about one inch in diameter. They receive their blood supply from various branches of the ophthalmic arteries which in turn are derived from the internal carotid. They have three tunics or coverings. The

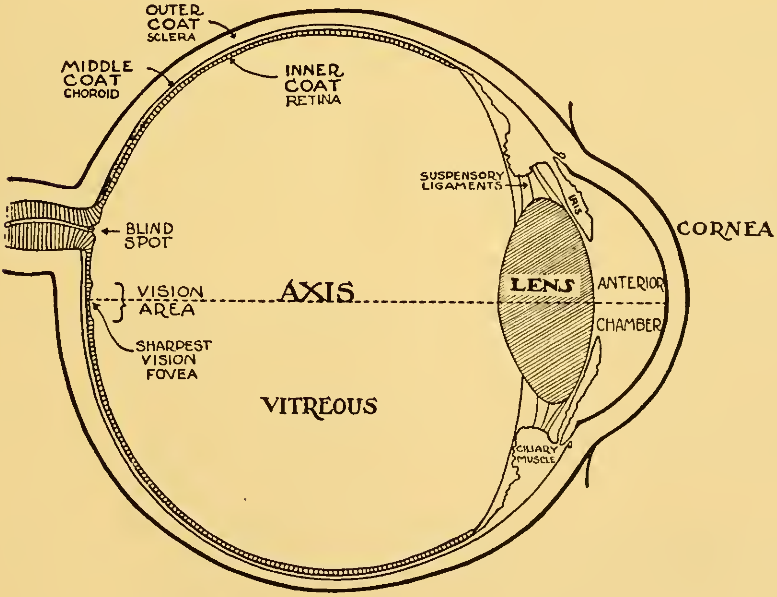

Fig. 2.—Horizontal Section—Left Eye

inside of the eye, although hollow, contains certain structures and substances which divide it into sections. The forward portion, known as the aqueous chamber, is filled with a fluid called the aqueous, and is further subdivided by the structures of the iris and part of the crystalline lens into anterior and posterior chambers. The rear two-thirds of the eyeball is filled with a mass known as the vitreous body.

**Cornea and Sclera.**—The outer tunic of the eyeball consists of the cornea and the sclera. The cornea is transparent and covers the front one-sixth of the eye, merging with the sclera, which is opaque, tough and inelastic. The latter is recognized as the white part and covers the posterior five-sixths of the eye. Together, the cornea and the sclera control the shape of the eyeball and protect its contents.

**Vascular Coat.**—The vascular coat forms the middle tunic and provides the chief blood supply, and hence nutrition, to the various structures within the eye. It consists of three parts—the iris being the most anterior section, the ciliary next and, back of that, the choroid. Together they form the uveal tract. These structures are so closely associated that when one is diseased the infection frequently spreads to the others.

**Iris.**—The iris is a circular membrane containing brownish or yellowish cells. The appearance of eye color is due to the effect produced by light reflected from these pigmented cells, the variations in shade being due to differences in the number, size and distribution of the cells. The more pigmentation there is in the iris, the darker the color, while a marked deficiency or an absence of pigment gives the pinkish appearance characteristic of albinism. (See **Albinism,** page 57.) The iris arises from the head of the ciliary body, and divides the anterior and posterior chambers, being separated from the cornea by the shape and depth of the anterior chamber. It is composed chiefly of muscle tissue, and is well supplied with blood vessels and nerves. At its center is a circular opening called the pupil, which automatically controls the amount of light admitted to the interior of the eye through action of opposing sets of muscles in the iris.

**Ciliary Body and Choroid.**—Extending backward from the circumference of the iris is a triangular section of tissue called the ciliary body, which includes the ciliary muscle and the ciliary processes. The ciliary muscle is sometimes called the muscle of accommodation because its function is to aid the eye in adjusting to near and far vision. (See **Accommodation,** page 21.) The ciliary processes, which are rich in blood vessels, support the ciliary muscle and are believed to secrete the aqueous. Continuous with the ciliary body is the choroid, a dark-brown membrane composed of capillaries, small arteries and veins. The choroid also has pigmented cells which help to darken the interior of the eye.

**Retina.**—The inner tunic is called the retina. This is a thin, transparent membrane, consisting of nine layers of nerve tissue,* which extends forward to the ciliary body. It is held in close contact with the choroid by the pressure of the vitreous body, but is attached only at its outer margin and at the optic nerve. (Detachment of the retina sometimes occurs as a result of injury, disease or defect, the amount of damage to sight depending on the location and extent of the area detached. Reattachment can often be effected with prompt treatment.) Blood vessels from the central retinal artery and vein spread out over the retina and can be seen and studied by means of an ophthalmoscope, often an important step in diagnosing vascular disturbances. Light rays reflected from objects viewed pass through the transparent structures and substances of the eyes to form images on the retina which are received by the nerve endings, and transmitted by nerve fibers, the optic nerve and tract to the visual centers of the brain. (See Chapter III, **The Seeing Process,** page 20.)

**Rods and Cones.**—In the outer layer of the retina are the nerve endings of the "nerve of sight"—the optic nerve. Cones provide sharp vision, while the rods have to do with a grosser type of seeing. The cones are more efficient in relatively bright light, the rods, in dim. In the periphery of the retina, rods are much more numerous than cones. The proportion of cones increases toward the center until, at the very center, there are only cones. When the pupil is contracted, most of the light is directed to this central area, thus aiding the efficiency of the cones. When the pupil is dilated, the light is spread over a larger area and, if the reason for the dilation is dim light, the rods become more efficient, but cannot take over the function of cones for detailed seeing.

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* Duke-Elder, Sir W. Stewart. *Text-Book of Ophthalmology.* C. V. Mosby Co., St. Louis, Vol. I, p. 86. 1934.

**Macula and Fovea Centralis.**—This central area where the cones are concentrated is known as the macula, having at its center a tiny pit known as the fovea centralis, where there are no rods at all. The macula is in the direct line of vision as the eyes are fixed on an object and is the area of the sharpest vision, detailed perception being possible only through its functioning.

**Visual Purple.**—In the retina is a chemical substance known as visual purple, which controls the ability of the retina to adjust to varying amounts of light. Under the influence of light this substance is changed to visual yellow, but in darkness a portion of the visual yellow reverts to visual purple; another portion undergoes decomposition into vitamin A and proteins. This process is continuous and reversible. The bleaching or adaptation to light is rapid, but the regeneration of the visual purple is much slower and its completeness is dependent upon an adequate supply of vitamin A in the retina. However, even with an adequate intake of vitamin A, other conditions may interfere with the process of dark adaptation, notably disturbances of the liver or of the gastrointestinal tract, malaria, diabetes, nephritis and anemia. The condition known as night blindness occurs in diseases of the eye such as congenital total color blindness and retinitis pigmentosa, or luetic optic atrophy; or it may be a hereditary condition.

**Optic Nerve, Tract and Visual Centers.**—As already shown, the optic nerve fibers of the retina converge to form the optic nerve. The head of the nerve, or optic disk, as it is called, is slightly to the nasal side of the macula. The optic disk is also the site at which the central retinal artery and vein enter and leave the eye, enclosed in the sheath of the optic nerve. Here there are neither rods nor cones, hence no power of sight, and so this is what is called "the blind

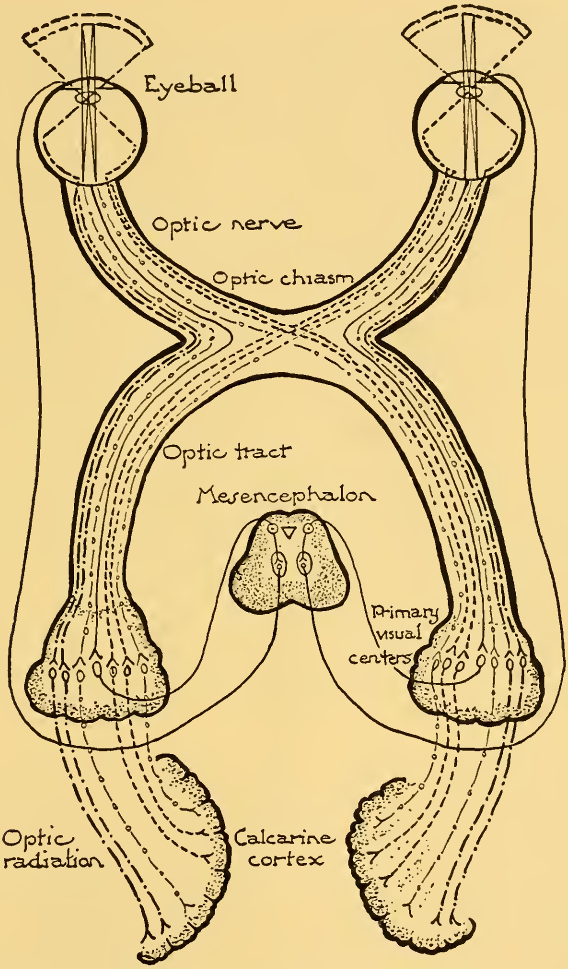

Fig. 3.—Chiasm and Optic Tracts

The visual pathway. This diagram indicates the reversal of the visual and retinal fields, the course of the fibers which arise from the various portions of the retina, and the path of the light reflex: — — — indicates the temporal fibers. — · — · — · indicates the nasal fibers. —o—o—o indicates the macular fibers. ———— indicates the light fibers. The uncrossed course of the temporal fibers, the crossed course of the nasal fibers, and the partially crossed and partially uncrossed course of the macular fibers are indicated. The primary visual centers, consisting of the pulvinar of the thalamus and the lateral geniculate body, are indicated together with the course of the optic radiation to the calcarine cortex. The switching of the light reflex stimulus from the primary visual centers to the tectum of the midbrain, and its connection with the efferent oculomotor neuron governing the sphincter iridis is also shown.

Redrawn from "The Visual Apparatus," by Henry Alsop Riley, in *A Textbook of Medicine* by American authors. Edited by Russell L. Cecil, M.D., 6th edition. Reproduced by permission from Wm. B. Saunders Co., Philadelphia, 1943.

spot." Leaving the eyes, the optic nerves pass through an opening in the orbit and come together in an incomplete cross, known as the optic chiasm, situated on the sphenoid bone above the pituitary gland. Here the nerve fibers from the nasal half of each eye cross to go to the opposite side of the brain. However, the fibers from the temporal side of each retina, although passing through the chiasm, do not cross—those from the right eye extending to the right side of the brain, those from the left eye to the left side of the brain. Thus, fibers from each eye go to both sides of the brain. A lesion on one side of the brain, therefore, may affect the sight of either eye or both eyes, even though the eyes themselves are normal; disturbances at the chiasm may also damage or destroy the sight of either eye or both eyes, depending on which fibers of the optic nerve are affected. Thus, when vision is lost or damaged without an apparent cause in the eye itself, it is sometimes possible, by ascertaining the parts of the retinae not functioning, to determine which pathways to the brain are affected.

The chief visual centers are in the occipital lobes of the brain, where seeing actually takes place. Here the visual impulses which have been received by the eyes and transmitted to the brain are fused and interpreted as the image of the objects viewed.

**Aqueous Chamber.**—The aqueous chamber derives its name from the clear, colorless, lymph-like fluid with which it is filled and which brings nourishment to the crystalline lens and cornea (neither of which contain blood vessels). This chamber is further subdivided into the anterior and the posterior chambers. The former is the space between the cornea and the anterior surfaces of the iris; the latter, the space between the posterior surface of the iris and the anterior surface of the lens. The aqueous is secreted into the posterior chamber by the ciliary processes, passes into the anterior through the pupil, and drains out through the canal of Schlemm, located at the angle formed by the junction of the cornea, sclera and iris. Interference with normal drainage results in the disease known as glaucoma (see page 85).

**Crystalline Lens.**—Suspended by ligaments attached to the ciliary processes, and immediately behind the iris and pupil, is the crystalline lens—a transparent, practically colorless body with convex surfaces. Its inner substances, consisting of a nucleus and cortex, are enclosed in a transparent capsule. The nucleus increases in size with age and the lens, which in youth is soft and pliable, gradually becomes firmer. The lens is an important part of the focusing mechanism of the eye, having the capacity to maintain the focus in relation to the distance of the object viewed. (See **Accommodation,** page 21.) However, as the pliability of the lens diminishes, it becomes less and less efficient for near work. (See **Presbyopia,** page 84.) An opacity in the lens is known as a cataract, a condition which may occur at any time before or after birth, but which is more common in older people (see page 85).

**Vitreous.**—Filling the space behind the lens is a transparent, jelly-like, but semi-solid, mass called the vitreous body. In addition to transmitting light to the retina it helps to support the lens and to hold the retina in close contact with the choroid.

## Chapter III.—The Seeing Process

SEEING is a co-ordinated and complex process involving the use of the eyes, the visual pathways and the visual centers of the brain, the co-ordination of muscles of eyes and lids, and also various head and body movements. The visual processes include central and peripheral vision, color vision, and binocular single vision which permits depth perception. They involve also the formation of images and their focusing on the retina, thus stimulating the nerve endings and creating impulses for transmission to the brain.

### The Refractive System of the Eyes

We see objects by the light which they reflect. This reflection takes the form of light rays traveling in straight lines in all directions. At a distance of 20 feet the divergence or scattering of the rays is negligible. Thus when we view objects twenty feet or more away, all the rays reaching the eyes are practically parallel; as the distance decreases, the rays become increasingly divergent. However, when rays pass through transparent substances of differing densities they are deflected or bent in degrees which correspond to the density and curvatures of the surfaces of each substance. This process is called the refraction of light, and the substances through which the light is transmitted are spoken of as refractive media.

When light rays enter the eye they pass through the cornea, aqueous, crystalline lens, and vitreous, which constitute its refractive media. Each of these, varying in density and curvatures, contributes in its own manner and degree to bringing the light to a focus, and forming an image of the object viewed, at the retina.

In passing through these media, the chief rays reflected from the object viewed cross on the retina; hence the image is inverted as on the film of a camera. The true position of the object is recognized through interpretation of the visual sensation, which of course is a mental process.

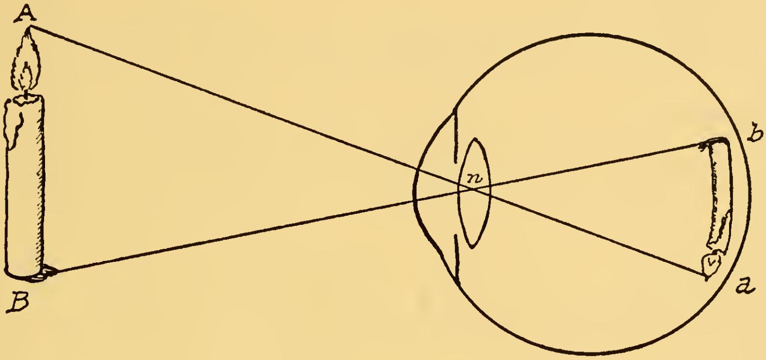

FIG. 4.—INVERTED IMAGE

**Central Vision.**—In normal vision, the image of an object which is in the direct line of vision is formed at the macula of each eye, permitting perception of detail through the concentration of cones at this point. This is known as central vision.

**Peripheral Vision.**—Images of objects in the area surrounding the direct line of vision are formed on the periphery of the retina. As these stimulate the rods rather than the cones, vision is indistinct; but, as it provides awareness of motion in the outer part of the field of vision, it is extremely important to safety.

**Accommodation.**—Accommodation is the name given to the process of automatically adjusting the focus in relation to the distance of objects viewed, to provide a clear image on the retina. It is accomplished by the action of the ciliary muscle, which varies the tension exerted on the crystalline lens, thus allowing it to increase or decrease its thickness, changing its curvatures (hence its refractive power) to maintain the focus at the proper place. Under ordinary circumstances this adjustment is needed only for seeing things at a distance of less than 20 feet—the nearer the object approaches the eyes, the greater is the amount of accommodation needed. Although certain refractive errors may necessitate some degree of accommodation even for distant sight, and proportionately increased amounts for near vision, seeing at a distance is more restful than at close range because it tends to relax the muscles of accommodation, wholly or to a marked degree.

The power of accommodation is at its maximum in childhood, when the lens is soft and pliable, and normally throughout youth there is sufficient reserve power in the ciliary muscles to permit ordinary and suitable visual activities without undue fatigue. Gradually, however, as the lens becomes firmer, the accommodative power decreases until, in midlife, clear vision for close work is no longer possible without glasses. (See **Presbyopia,** page 84.)

**Emmetropia.**—This term is used to designate normal refractive powers. To be considered normal (or emmetropic), the eye must be able to bring parallel rays of light (those from a distance of 20 feet away) to a focus on the retina without the use of accommodation. The size and shape of the eyeball influence its refractive powers, the most important aspects being the length of its axis from front to back and the curvature of the cornea and the lens. The typical emmetropic eye is usually 23 millimeters (about ⅞ of an inch) in depth.

## Errors of Refraction

**Ametropia.**—When, because of a defect in the optical system, the image cannot be focused clearly on the retina, or the focus cannot be maintained for varying distances, the condition is described as an error of refraction, or ametropia, producing nearsightedness (myopia), so-called "farsightedness" (hyperopia), or astigmatism. These defects in significant amounts put a strain on the individual, either because of the effort necessary to see clearly, or, if a clear image can be obtained at one distance and not at another, because there is usually a tendency to concentrate on activities at the most comfortable range, to the neglect of those which cannot be seen distinctly. The term "eyestrain," however, is not a desirable one with which to describe the symptoms of such defects. In many instances the strain is muscular or nervous and, according to popular conceptions, such strains are believed to be the cause rather than the result of the defects.

**Hyperopia.**—The typical hyperopic eye is one which is relatively shorter (from back to front) than the emmetropic eye, so that the point of focus for parallel rays of light is behind the retina. Thus, to obtain a clear image, some degree of accommodation is needed even for distance seeing, and a greater than normal amount is needed for close work. Viewing objects for close work necessitates convergence (turning the eyes in), as well as accommodation. Hence these two functions have a close psychological association. Stimulation of one tends to stimulate the other. Since the hyperope uses both eyes continuously, there is a tendency to overconverge. (See **Strabismus,** page 26.) Whether this continuous use of accommodation produces fatigue and strain depends upon the degree of hyperopia, the individual's tolerance, interests, and upon the extent to which close vision is employed. Because of the discomfort it produces, hyperopic individuals tend to avoid close work. All of these factors are taken into consideration in determining the need for glasses.

Although hyperopia is commonly called "farsightedness," the hyperopic eye is not capable of seeing farther than the normal; but, as indicated above, is better adjusted for seeing at a distance than for close vision.

Children are normally hyperopic, a point which needs to be considered in planning any activities requiring the close use of the eyes.

**Myopia.**—In myopia, commonly called "nearsightedness," the eyeball is usually relatively long so that parallel rays of light reach a focus in front of the retina. As the eye has no mechanism for overcoming this, the object must be brought nearer to the eye, where the rays of light will be sufficiently divergent to be focused on the retina so that the object can be seen clearly. This results in relatively less use of accommodation and, although convergence is needed for the increased use of near vision, in myopia this function is often weak because of lack of stimulation by the use of accommodation. (See **Strabismus,** page 26.)

There is no "eyestrain" from nearsightedness. The myopic person overcomes the difficulty of being unable to see distant objects by disregarding them and focusing his attention on those which he can bring close to his eyes. His difficulty often leads to lack of exercise and poor posture habits. High myopia, if accompanied by a pathological condition of the eyes, may result in detachment of the retina, retinal hemorrhages, and other types of retinal damage.

**Astigmatism.**—Irregularities of the curvatures of surfaces of the lens, or more often of the surfaces of the cornea, produce the condition known as astigmatism. Light rays passing through these structures are refracted abnormally in the meridians in which the irregularity occurs, which prevents their being properly focused on the retina. If the irregularities tend to make the focal length of the light rays longer than is normal, the astigmatism is hyperopic (because rays passing through the affected meridians will be focused behind the retina). Conversely, if the defect results in making the focal length of some light rays shorter than normal, the astigmatism is myopic. If some meridians produce a hyperopic astigmatism and others a myopic, the condition is described as mixed astigmatism.

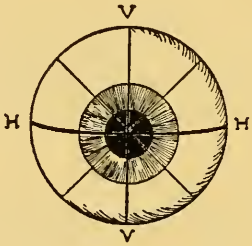

FIG. 5.—ASTIGMATISM

A significant amount of astigmatism results in a blurred or distorted image which the person tries, ineffectively, to overcome through adjustments of focus, narrowing the lids and contracting the pupils. These continuous, futile efforts cause strain, fatigue, and often headache and general discomfort.

**Corrective Lenses.**—Although this term is used for describing glasses prescribed for refractive errors, they are an aid more than a corrective device, inasmuch as they do not cure the condition but offset the refractive defects of the eyes.

Lenses may be spherical, cylindrical, or a combination of both. Spherical lenses are used for hyperopia and myopia, and cylindrical lenses for astigmatism. Spheres for hyperopia are convex and are commonly called "plus lenses," because they add to the refractive power of the eye. Those for myopia are concave, or "minus lenses." The convex lenses converge rays of light, bringing them to a focus at a shorter distance; while concave lenses diverge the rays, thereby extending their focal length. Cylinders may be plane in some meridians and convex (for hyperopic astigmatism) or concave (for myopic astigmatism); and some meridians may be convex and others concave (for mixed astigmatism).

The strength of the lens is described in diopters (D), the unit of measure of its refractive power. The higher the number of diopters, the stronger the lens.

**Prisms.**—A prism lens is one which changes the direction of rays of light but has no power either to converge or diverge them. An object seen through a prism appears displaced toward its apex. Prisms are sometimes used to counteract the effects of strabismus, the apex being placed in the opposite direction from that toward which the eye deviates. The strength of prisms is indicated in prism diopters (PD or a triangle), or in degrees, and the direction of the apex is also stated in prescriptions.

### Binocular Single Vision

When the eyes are fixed on a central point, the area seen by each eye forms an arc with the eye as its center. The nasal portion of these arcs overlaps, so that the central part of the area is seen by both eyes simultaneously, while the outer portions are seen by each eye separately. Thus each eye receives slightly different views, with objects in the direct line of vision being seen by both together and those in the periphery by each separately.

Through binocular single vision the two images perceived by each eye separately are fused into one, and depth perception is achieved. For this several factors are necessary.

1. The eyes must fix on an object in such a way that the corresponding areas of the two retinae are stimulated simultaneously by the same object, thus obtaining slightly different views of the object.
2. The images formed on the two retinae must be of approximately equal size, shape and clarity.
3. The visual pathways to the brain must be complete and functioning adequately.
4. The brain must be able to fuse the two images and interpret them as one.

Accuracy in estimation of the size and distance of an object is dependent upon binocular single vision. Experience may sometimes help to compensate for lack of depth perception.

**Strabismus.**—Co-ordination of the eyes should be sustained regardless of the direction in which they are turned or the distance at which objects are viewed. Lack of this normal alignment, whether continuous or occasional, is known as strabismus, "cross-eye" or "squint." The latter term often leads to confusion because, in common parlance, the word "squint" is used to describe a narrowing of the lid apertures. Therefore, in discussing strabismus with a layman, if the term "squint" is used it is necessary to explain what is meant.

Strabismus may be either manifest or latent. When manifest, the deviation in alignment is evident. This condition is designated as a "tropia." In latent strabismus alignment is maintained through effort; the difficulty is not evident. This is known as a "phoria." It is usually discovered by means of a test for muscle balance. The direction of the deviation in either manifest or latent strabismus is indicated by the use of prefixes—"eso" to indicate a turning-in, "exo" for out, "hyper" for up, and "hypo" for down; or the prefix "hetero" may be used to indicate a lack of alignment without specifying the direction. The prefix "ortho," as in "orthotropia" or "orthophoria," indicates normal alignment.

In strabismus, whether manifest or latent, one eye may be used continuously or either eye alternately. In the latter, known as alternating strabismus, the sight may remain equally good in both eyes; in the former, the sight of the unused eye tends to deteriorate, usually resulting in what is known as amblyopia ex anopsia (weak vision from non-use).

Among the common factors contributing to strabismus are weakened or paralyzed extraocular muscles and refractive errors, especially when these errors produce unequal vision in the two eyes. (For further discussion of strabismus and its treatment, see page 67.)

## Color Vision

Light rays of different wave lengths produce sensations which are interpreted as colors. Color is, therefore, not a characteristic of the light itself, but is rather the psychological response to a particular type of stimulation of retinal elements caused by the varying wave length of the light rays. Although there are several theories concerning color vision, the exact psychological process by which the stimulation occurs is not known. Perception and interpretation of color are, of course, brain functions.

By normal color vision is meant the ability to distinguish colors of which red, yellow and blue are the basic factors, other colors being a combination of these. Conversely, color blindness is the inability to distinguish colors. Color blindness may be complete or partial. In the former, there is total absence of the perception of these basic colors; in the latter, lack of perception of some colors. The most common form of color deficiency is red-green blindness.

Defective color vision is usually hereditary, and is more common in males than in females. People are often unaware of their difficulty because they can compensate for it in some measure. Many efforts have been made to correct color blindness but, thus far, without generally accepted results. When color blindness results from disease, treating the cause may improve color perception.

## Chapter IV.—Making the Best Use of the Eyes

DEMANDS on sight vary greatly both in their nature and extent. Sometimes, as in walking, the eyes may be used quite casually and chiefly for distant seeing. Again, it is necessary to scrutinize objects closely and to perceive their details, as in reading, fine sewing, drafting and many types of industrial work. In some situations, the location of objects in space and their relative positions must be interpreted with accuracy and speed. Correct perception of colors is often essential to safety and efficiency. It may be necessary to be aware of objects or their motion in the peripheral field. Thus the various visual functions are called into play, usually in combination or with quick shifts from one to another, as from distant to near vision. Often, visual attention must be sustained on one type of work over a considerable period of time. All of this can be greatly facilitated by good visual working conditions.

### Light and the Eyes

The eyes are provided by nature with the ability to adjust to great extremes of light. The opaque sclera, the dark lining provided by the vascular tunic, contraction and expansion of the pupils and lids, and the shading afforded by the brows and lashes, all help to control the amount of light entering the eyes in relation to the particular visual effort being made.

In dim light only gross seeing is possible and colors are distinguished poorly, if at all. For perceiving details and discriminating colors, a relatively bright light is needed; but glares (whether direct or reflected) cause discomfort and interfere with visual efficiency. For example, it is undesirable to read in the sunlight, even if the reading material itself is shaded. The eyes function best when there are not too great differences between the brightness of the working surface and the surrounding area.

**Sensitivity to Light.**—Although individuals vary in their sensitivity to light, glares (bright spots within the field of vision) cause annoyance, discomfort and fatigue and lower the visual efficiency for all. With certain types of visual defects and ocular diseases, and during illness, light sensitivity is increased.

**Sun Glasses.**—Daylight is the natural environment for the eyes. Normally, one should be able to adjust to ordinary daylight without discomfort, although the eyes should be protected from prolonged exposure to sunlight by the use of either an eye shade or sun glasses. The latter, however, should be used only during the periods of exposure to sunlight, unless a more continuous use is recommended on the basis of a careful eye examination. The color of the lenses is largely a matter of choice, but sun glasses should not alter the hues of natural scenery. Indiscriminate use of sun glasses may tend to lower the tolerance to light. They are meant for daytime use only, and in night driving are a hazard rather than a help.

## Lighting and Room Arrangements

As the arrangement and decoration of a room influence the amount and distribution of light, they are quite as important as the lighting provisions themselves.

**Principles of Lighting.**—Principles of illumination are the same whether natural or artificial light is used, namely, a sufficient amount of light for comfort and ease of seeing, correct diffusion, direction and distribution, and, above all, absence of glare. It is evident that the nature of the task to be performed and the condition of the eyes must be taken into consideration in determining the best lighting facilities.

**Measurement of Light.**—The amount of light needed varies in relation to the demands of visual tasks and to the needs of individuals, which differ with age and the condition of the eyes. Older people and those with poor sight tend to need relatively more light than the young with normal eyes. Astigmatism, even of a fairly low degree, increases the intensity needed for detailed seeing, but also increases sensitivity to glare.

Amount of light is measured in foot-candles. One foot-candle represents the amount of light cast by a standard candle one foot away from the light. Ten foot-candles is the amount of light cast by ten such candles at the same distance. This is considered the minimum for reading even for a short time. When prolonged, detailed eye work is to be done, more light is needed.

Fixed standards for quantity of illumination are, of course, not possible because of the variations already noted. However, desirable minima have been established for schools and industries.

Although scientific evaluation of lighting is a special field, simple and inexpensive light meters make possible fairly accurate measurements. Light meters should be handled with care, kept covered when not in use, and periodically serviced and checked for accuracy. Frequently, they may be borrowed from local departments of education or health, or from a lighting company, or be purchased through the latter or directly from several manufacturers of standard electrical equipment.*

The individual who has become accustomed to his working conditions may not realize that the illumination is preventing him from doing his work with ease and efficiency. Indeed, at times he may object strenuously when improved lighting is provided. Experience shows, however, that conditions conducive to visual efficiency will prove comfortable after prejudices have been overcome.

**Lighting Arrangements.**—Daylight is to be preferred to any type of artificial light, but in a room where any kind of close work is done it must be supplemented by artificial illumination to make adequate provisions for all parts of the room, for dark as well as bright days, and for night use. Windows should, however, be used to the fullest possible advantage. The nearer these go to the ceiling, the farther they will cast light across the room. Shade, blind and curtain arrangements can help to direct and diffuse the light and should be planned in relation to the purpose for which the room is to be used. Buff, translucent shades help to diffuse light and, where desirable, the use of separate shades for each sash permits control of the light from the upper and lower parts of the window. The slats of Venetian blinds, on the other hand, all turn together to direct the light up or down and thus tend to increase the shadows.

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* Information concerning the availability of light meters may be secured from the National Society for the Prevention of Blindness, 1790 Broadway, New York 19, N. Y.

Hence they are often unsatisfactory for rooms where much close work is done. Clean, light-colored walls and ceilings aid in the diffusion of light. Dull-finished surfaces throughout the room and on working surfaces help to minimize glare. Cleanliness of walls and ceilings is important in maintaining maximum reflection value of their surfaces.

Turning furniture at approximately 30 degrees away from windows helps to prevent glare and permits taking maximum advantage of the daylight for visual work.

For handwork, arranging for the light to come over the shoulder opposite from the hand used prevents a hand-shadow on the work.

**Artificial Light.**—Artificial light should approximate daylight in its diffusion as well as in its coloring. At present, white incandescent lamps are generally believed to give the best results as to color of light. Some blue of "daylight" bulbs is useful in matching colors, but less satisfactory for reading and general purposes.

Fluorescent lighting is now being widely advocated by lighting authorities and will undoubtedly have increasing use in the future. However, although it consumes less current and is therefore cheaper to operate, the installations are costly at the present time. Hence there is a tendency to use fewer and cheaper types of fixtures, resulting in inadequate distribution and diffusion of light. The stroboscopic effect, or flicker, found in the earlier installations has been practically eliminated in the newer ones. Despite these improvements, current research is leading some ophthalmologists to caution against installing fluorescent lighting at its present stage of development.

There are four general types of installation used in artificial illumination: direct lighting, in which, as the name suggests, the light is all directed downward; semi-direct lighting, in which the greater amount is directed downward; semi-indirect lighting, in which more than 50 per cent of the light is directed upward and reflected from walls and ceiling over the area to be illuminated; indirect lighting, in which 90 per cent or more of the light is directed upward.

The selection of the system depends upon the type of work to be undertaken. Ceiling fixtures or luminaires may be used, or a combination of ceiling luminaires and supplementary local lighting, such as floor, desk, and table lamps. In general, the indirect or semi-indirect types of illumination are most satisfactory, although for work requiring careful inspection supplementary direct lighting units are necessary. These should be so shaded and placed that there is no possibility of the light shining into the eyes of the worker. If supplementary lighting is needed for reading, writing, sewing, etc., a floor lamp providing semi-indirect illumination may be so placed that the light comes over the shoulder.

**Lighting the Home.**—Overhead semi-indirect illumination provides good distribution for home use, supplemented where necessary by direct illumination over working surfaces or by semi-indirect reading lamps.

In the kitchen, a ceiling fixture with a diffusing globe may be the most satisfactory for general lighting, with properly shaded direct lights over worktables and the sink. Indirect light is adequate in a dining room used for meals only; but if the room is used also for reading and study, the light should be supplemented by semi-indirect reading lamps, preferably the floor type. Similarly, in the living room, reading lamps—both floor and table type—are needed so that each member of the family may have a comfortable place in which to read or do other types of visual work.

In bedrooms, soft overhead lights are desirable, and may be supplemented by properly shaded lights on both sides of the mirror. Similar lights may also be used in the bathroom to supplement the overhead light. A semi-indirect pin-up lamp over the head of the bed usually provides the most satisfactory light for reading in bed. This practice is not harmful to the eyes if the reader maintains normal posture, if the book is carefully placed for comfort of seeing, and if the light is adequate in quality and quantity.

In children's rooms, a combination of overhead and wall fixtures with semi-indirect lighting provides the general and localized lighting necessary, and eliminates the accident hazards from floor and table lamps.

Halls and staircases should receive special attention. In the former a diffused type of lighting is to be preferred, while a semi-direct type will usually light stairs adequately. It is particularly important to avoid the use of a glaring type of lighting on a staircase.

**Visual Comfort for the Sick.**—Light is often a source of much discomfort during illness, when light sensitivity may be increased. Whether from a natural or an artificial source, the light should not shine in the patient's face. If possible, the bed should be so placed that the patient will not face the window. If this cannot be arranged, the light should be controlled by adjusting the shades and, if necessary, using a screen. Lights from overhead fixtures should be shielded. When permitted at all, reading or other close work should be limited to brief periods when the patient is not fatigued. Attention to posture, lighting, and the angle at which the book is held will help prevent undue fatigue. Back rests and reading racks are very useful for this purpose. For the patient who must lie flat, special arrangements for reading are necessary to maintain the proper angle between the eyes and the book and to provide adequate light. Here a reading rack is essential unless the doctor permits the slanting of the whole bed.

**Lighting the School.**—Lighting the school* presents many problems. Classrooms which permit the maximum use of daylight are those with a glass area equal to at least one-fifth of the floor space, and extending close to the ceiling.

Natural illumination should be controlled by two light-colored, translucent shades placed at the center of the window, one rolling up and the other down.

Children's desks and seats should be movable, so they can be turned diagonally from the window to permit the maximum use of daylight and to avoid glare. For the right-handed, the desks should be turned at an angle which allows the light to come over the left shoulder, while for the left-handed the light should come over the right shoulder.

To encourage good posture and good visual habits, the children's desks and seats should be adjusted as to height and spacing as often as necessary for their growing bodies. Desks with adjustable, sloping tops also facilitate good visual habits and good posture.

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* *American Recommended Practice of School Lighting.* Illuminating Engineering Society, 51 Madison Ave., New York; and The American Institute of Architects, Washington, D. C., 1942, 25c.

Artificial light is needed in all classrooms to supplement the daylight, especially on dark days. In many classrooms it must be used continually on the side of the room away from the windows; hence the rows of luminaires should be on separate switches, to control the lighting from the two sides of the room. The artificial lighting should be adequate in itself to provide at least the minimum recommended amount, especially if the room is ever to be used after dark. For ordinary classrooms, the recommendations indicate a minimum of 15 foot-candles on desks and other working surfaces for children with normal vision, and 30 foot-candles for those with seriously defective vision. Higher amounts are recommended for places in which detailed or close eye work is carried on. Semi-indirect light or indirect luminaires with translucent bowls appear to give the most satisfactory results.

Glass doors and other shiny surfaces should be covered or eliminated to reduce glare. Chalkboards reflect very little light; hence they tend to reduce the amount of light on working surfaces. This can be overcome by the use of light-colored curtains to pull over those not in use.

Corridors and stairways should be adequately lighted at all times.

**Lighting in Industry.**—In industry, lighting is an important factor in safety and production. Well-lighted corridors, aisles and stairs help to prevent accidents. Such lighting should be diffused, free from glare and of adequate amount to permit obstructions or steps to be seen easily and clearly. For detailed and exacting work, general illumination usually must be supplemented at the work point. Such lights should be shielded to prevent glare either for the individual worker or for those nearby. Glare may also be reduced and seeing facilitated by painting the machines with dull-finished paints, using contrasting colors for various parts of the machine. Certain types of inspectional work are facilitated by what is called "directional lighting"—light directed on the work at such an angle that even very slight irregularities on the surface are easily discernible.

Because of variation in the visual demands in industry, no generalization can be made regarding amounts of and arrangements for desirable illumination. However, specifications have been developed for recommended practices of lighting for particular types of work in various industries.* The amounts suggested indicate the minimum light needed at the work point and for general lighting. Periodic checks with a light meter are necessary to be sure the light continues to be adequate. Plant housekeeping is an important factor in good lighting. Clean, light-colored walls and ceilings with dull finish reflect the light without contributing to glare. Clean windows and lighting fixtures, and replacement of deteriorated bulbs, increase the amount of light available from these sources and prevent wasted illumination. Routine schedules should be arranged for maintaining these facilities at maximum efficiency.

**Minimizing Fatigue Through Arrangements of Work.**—Comfortable working positions contribute to visual and bodily comfort and help prevent undue fatigue. Viewing work at the normal angle to the eyes and at appropriate working distances is conducive to good posture and results in less general muscular strain. Adjustable seats facilitate good posture; and desks and work tables with tops which can be slanted encourage keeping the head up rather than bending over work. This is particularly important for those with seriously defective vision and those who do continuous eye work at short range, as they tend to bring their eyes close to the work and thus develop poor posture.

The spread and shape of the working area should also receive consideration in relation to the type and continuity of visual attention required. In this connection it is necessary to remember that details can be perceived only in the direct line of vision, and, if these are not directly in front of the individual, the eyes or head must be turned to obtain clear impressions. Some types of visual work may be slowed up by too great a spread, and fatigue may result from such continued efforts, especially if speed is necessary or the individual's visual capacities and general co-ordination are not equal to the demands. Accident hazards may also arise from the necessity of taking the eyes from a central point to look at something elsewhere.

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* *American Recommended Practice of Industrial Lighting.* Illuminating Engineering Society, 51 Madison Ave., New York, 1942, 25c.

Distractions caused by moving objects in the peripheral fields of vision increase fatigue because of the nervous strain of striving to ignore these; or an accident may result if attention is thus distracted momentarily from the central point.

**Reading Materials.**—Reading requires accurate discrimination of fine detail and speed in seeing and can be greatly facilitated by the use of reading materials of good quality and workmanship. Although it is questionable whether reading poorly produced materials injures the eyes, the greater ease and comfort with which high-standard materials are read lessen fatigue and nervous strain, and make careful selection of reading material well worth while.

The quality of printed and typewritten material may be judged by its freedom from glare, its general appearance, and its distinctness. Glossy paper and ink are to be avoided because of reflected glare. Contrary to popular belief, green paper is less "easy on the eyes" than dull-finished white or cream-tinted paper, because it offers less contrast between the print and the background. Wide margins are to be preferred, and lines of print are more easily read if not over 4½ inches in length; typed lines should not exceed 6 inches. Sufficient space between letters and lines to avoid a crowded appearance makes reading more comfortable. Plain type with sharp edges is the most distinct. Type sizes are indicated in points, the lower numbers referring to the smaller sizes. Newspapers are usually printed in 6-point type, while the type of this text is 11 point. For general use, type sizes smaller than 8 or larger than 12-point are less satisfactory; larger type is, however, necessary for very young children and for those with certain degrees or types of visual defects.

# Chapter V.—"Screening," Eye Examinations, and Follow-Up

IMPAIRED vision or blindness can often be prevented, and nervous strain from defective sight relieved, through early recognition, correct diagnosis, and proper treatment of eye conditions. Eye diseases and defects are often present without being recognized either by the individual or those around him until considerable damage has resulted either to sight or to efficiency.

Periodic, comprehensive eye examinations are the ideal means of early discovery and diagnosis of such conditions, but, when such a program is not feasible, periodic "screening" tests of vision and observations to note signs of eye trouble are helpful in locating persons needing care. These, however, are gross tests, serving only to indicate the probability, not the proof, of the need of eye care, and are insufficient for diagnosis. This fact should be understood by all concerned—those making the screening, those tested, and all others interested.

After the screening, the need of a proper examination for those suspected of having eye difficulties must be recognized; guidance and assistance should be offered in planning and making the necessary arrangements. After the examination, in carrying out recommendations, encouragement and help may also be needed for an indefinite period of time.

A program for early diagnosis and care of eye difficulties includes:

1. Early discovery through periodic screening of groups of individuals.
2. Comprehensive eye examination for each one who seems to have any visual or eye difficulty.
3. Follow-up to aid in securing eye examinations and in carrying out recommendations.

## Screening for Eye Difficulties

Visual screening programs require:

1. Co-operation of all concerned.

2. Careful selection and preparation of personnel to give tests, observe reactions, and explain follow-up procedures.
3. Provision for the use of suitable, standardized procedures and equipment for testing, with proper facilities for conducting the tests.
4. Careful interpretation of screening procedures, results and recommendations to all undergoing the tests.

Even under the most favorable circumstances, a few who need care are likely to be missed; while others may be "screened out" who, on examination, will be found to have no eye difficulty requiring attention. Comparative studies are the only means by which an accurate estimate of this margin of error can be obtained. In such studies, findings of the various tests of a sufficiently large cross section sampling of the group screened are compared with those obtained by an eye specialist through a diagnostic examination of the same visual functions as were grossly tested in the screening.

**Preparation for Visual Screening Programs.**—The first step is to seek help in planning a program which will be practical and valuable. In this, those administratively responsible, eye specialists, and the personnel to do the work, can give the greatest aid. With the administrator rests the responsibility for provision of facilities, selection of personnel, arrangements for necessary training, and the general planning of the program.

Eye specialists can help in the selection of suitable screening procedures, in outlining facilities needed, in training of personnel, and in interpreting the program to their colleagues. Community agencies can assist in planning the follow-up.

**Selection and Training of Personnel.**—Careful selection and training of the persons who are to make screening tests and observations greatly affect the reliability of the results. The essential qualifications are that they be capable of being instructed: (a) to do the work in an orderly, businesslike, but kindly, manner by making good contacts with the individuals to be screened; (b) to follow instructions carefully and have the necessary knowledge and skills; (c) to be alert to signs of eye difficulty; (d) to keep accurate records; (e) to make such interpretations of their findings as lie within the scope of their functions.

Preparation should include explanation and demonstration of tests and observations, and practice under supervision until proficiency is established.

Personnel for follow-up need equally careful selection and preparation, to assure correct interpretation of the significance of the screening, and provide adequate guidance to sources for a careful examination and such other services as may be required. Persons to do this work therefore should: (a) Be capable of conducting individual interviews skillfully and of interpreting scientific material to individuals with various backgrounds and knowledge; and (b) be familiar with local resources for eye care and the ethical procedures for guiding people to them.

Basic skills for the above usually require a high level of professional preparation, such as that required for public health nursing or for medical social work.

**Preparation of the Individuals to be Screened.**—Careful interpretation of the purposes and limitations of the screening process, before the tests and observations are made, prevents misunderstandings and paves the way for follow-up. It should be made clear that the screening is not a substitute for an eye examination. When suitable, the difference between a comprehensive examination by a qualified eye specialist and the screening procedures may be pointed out and information may be given about community resources for eye examination and care.

The tests themselves need explanation so that each person knows how to co-operate. For some individuals, especially young children, a preliminary drill is desirable.

**Screening Procedures.**—Screening procedures must be suited to those to be tested and to the particular situations in which the screening is to be carried out. In selecting those most suitable, the following points should be considered:

1. Signs and symptoms of eye difficulties should be noted, to supplement information obtained from the tests.
2. A battery of tests is needed to measure the performance of various aspects of visual functioning.

3. Only well-recognized tests and procedures should be used for screening; new test methods or devices should be adopted only after careful validation and under proper guidance.
4. Tests and procedures should be suited to particular situations and individuals, necessary adaptations being made under expert guidance.

**Observations, Inspection, and Attention to Complaints.**—Observation, inspection, and attention to complaints supplement test findings and sometimes provide in themselves sufficient evidence to warrant referral for an eye examination.

Symptoms for which *immediate ophthalmological* care should be sought include:

Swollen, inflamed lids, especially if the eyes are bloodshot and there is a purulent discharge.

Severe ocular pain, with or without redness of the bulbar conjunctiva or sclera.

Any sudden change in vision such as double vision or dimming sight.

Other symptoms which should be investigated include:

Lid irritation, such as sties, crusted and inflamed lid margins.

Signs of fatigue from eye work, such as: discomfort, dizziness, headaches, nausea, scowling, rubbing eyes, frequent blinking, or inability to do close visual work for a reasonable period.

Apparent use of one eye.

Crossed or divergent eyes.

Irregularities of pupils of the eyes, or their failure to react normally to light.

Unusual head positions.

Undue sensitivity to light.

Inability to see distant objects.

Holding of reading material or other fine work unusually *near* or unusually *far* from the eyes to see it clearly.

Proneness to accidents: stumbling over objects in path or failure to appreciate height of steps, getting fingers caught in machines, automobile accidents, etc.

**Types of Screening Tests.**—Visual functions usually considered most important to test are central visual acuity (distance, near and at working distance), peripheral vision, muscle balance, and color vision. Fusion and depth perception are also sometimes included when vocational guidance is one of the objectives of the screening.

As no one test can measure all of these aspects of vision, it is necessary to use a battery of tests. Such a battery may consist of recognized tests similar to those used in clinical practice, or it may be decided to use a stereoscopic testing device which affords tests of the various functions.

## Description of Screening Tests

The following tests* are among those most commonly used for preschool, school and industrial groups:

**Snellen.**—This is the standard test of distance central visual acuity; for most screening purposes it is considered the most important single test. It consists of reading test objects (letters, numbers or symbols) from a distance of 20 feet. The objects are of graduated sizes and constructed according to scientific optical principles. Each size is numbered to indicate the standard distance at which a person with normal visual acuity should be able to distinguish it. Hence one is said to have "normal" distance central visual acuity if he can see the 20-foot size or smaller from 20 feet away. At the same time it must be remembered that such a standard is not always possible for young children, even when their sight is normal.

For convenience, the results of this test are expressed as a fraction, the numerator indicating the distance from the chart, the denominator, the smallest size objects read correctly. It must always be borne in mind that this is not a fraction, and cannot be interpreted to indicate the percentage of visual efficiency. For example, 20/30 indicates only that the 30-foot line is the smallest line read correctly at 20 feet. It represents 91.5 per cent of visual efficiency, according to standard tables of equivalents of visual efficiency. Generally, 20/20 is considered "normal vision." Those with a visual acuity of 20/15, or 20/10, have an unusual degree of visual efficiency.

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* Detailed outlines of these screening procedures, for children or for adults, are available from the National Society for the Prevention of Blindness.

The chart is placed with the 20-foot line* of test objects approximately at eye level, and, according to many authorities, for screening it should be provided with 8–12 foot-candles of evenly distributed light. A standard chart unit, providing the desired amount of light, is usually more satisfactory than one with improvised illumination. However, as some units are more brightly lighted than others, care should be taken to select one with the desired standard of approximately 10 foot-candles. Portable types are available.† Room lighting should be adjusted to at least one-fifth the amount on the chart, and should be free from glare and sharp shadows.

Each eye is tested separately, with the other completely covered by a clean white card. Then both eyes are tested together. If glasses are worn, testing first with and then without encourages the best performance. Memorizing can be prevented by not having objects read in sequence, or by using cards with holes of proper size to show only one letter at a time.‡

**Plus-Lens Test.**—The Snellen test shows only the degree of distance visual acuity, without giving clues to the cause when this is low. But as it is possible, with significant amounts of hyperopia, to pass the test as normal or approximately so, some authorities recommend employing a simple test for hyperopia. This is done with a Snellen chart and hyperopic lenses of a specified strength. With this test it is necessary to use only the 20/20 line of the chart, since if this can be read with the lenses the person is inferred to have at least the degree of hyperopia represented by the strength of the lenses. Hence, ability to read the 20/20 line with the glasses constitutes "failure" in the test. Yet this does not necessarily indicate that the person needs glasses—a matter which can be determined only by a thorough eye examination.§

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* When space is limited the test can be made at a distance of 10 feet by using a mirror and a special Snellen chart designed for reverse reading, but this complicates problems of chart and room illumination for proper testing, and causes the chart to be viewed at an unnatural angle.

† Information on portable, lighted chart units is available from the National Society for the Prevention of Blindness.

‡ An inexpensive set of cover and window cards for this purpose is available from the National Society for the Prevention of Blindness.

§ This test is included in the battery of tests known as the Massachusetts Vision Test, full instructions and equipment for which are available from the Division of Child Hygiene, Massachusetts Department of Public Health, 73 Tremont Street, Boston, Mass.

**Tests of Near Vision.**—Several types of near-vision test charts are available for testing vision at approximately 14–16 inches. Some have printed paragraphs of graduated size, and others block letters or symbols drawn to Snellen scale, to be read at a stipulated distance. The Jaeger is an example of the former, while the Reading-Rating chart published by the American Medical Association is of the latter type. In recording results, the distance at which the test is given and the type of chart should be indicated. There should be 10 foot-candles of light on the chart and the person should not face a light. As in the Snellen test, each eye is tested separately, then both together, with and without glasses.

**Estimating Size of Visual Fields.**—A rough measure of the extent of peripheral vision can be obtained by the confrontation test. This consists of ascertaining at what point above, below, and to each side of each eye, a person becomes aware of a large pinhead, which is kept in constant motion, and moved in an arc toward the center of the field of vision. Normally, while the pinhead is not seen clearly, its presence and motion are discerned almost as soon as it passes the bony orbital rim from any direction. This, however, varies somewhat with facial configuration.

**Test for Muscle Balance.**—For this purpose it is desirable to test: the muscle balance with eyes looking straight ahead; the ability to converge; and the co-ordination of the eyes as they are rotated. For the first of these, either the cover test or a Maddox's rod test may be used. The object of the cover test is to discover if the alignment of the eyes is maintained when one eye is covered briefly while the other is fixed on a bright object. The person looks at a light which, for the distance test, is placed 20 feet away, and for the near test at about 14 inches. The tester holds a small card in front of one of the subject's eyes in such a way that the light cannot be seen with that eye, but it can be watched to see if alignment is maintained. After a few seconds the card is shifted to cover the other eye—the eye which was previously covered being watched for a shift in the direction of its gaze. Normally, there should be no change in its position, either while the eye is covered or when the cover is removed.

An ingenious device for using Maddox rods for screening purposes has been developed under the auspices of the Massachusetts

Department of Public Health as a part of the battery of tests known as the Massachusetts Vision Test. When a light is viewed through the type of lens known as a Maddox rod, it is seen as a streak of light, its direction being determined by the rods of the lens. In the Massachusetts test two pairs of spectacles are used, each with a Maddox rod for the right lens only, one to produce a horizontal streak, the other a vertical. The light is set in a small opening in a chart, which is drawn to resemble a house with the light in a window. This house-chart conforms to a definite scale so that, if the streak is seen outside of a specific area, it indicates what is considered a significant degree of muscle imbalance. This test is made at a distance of 20 feet, and a similar one with a small block and a pinpoint of light is made at 16 inches.

While some authorities recommend this test for muscle balance in the central position, others prefer the cover test.

Convergence can be tested by having the person watch a pinhead slide along the edge of a rule toward the bridge of the nose. The rule is placed with the zero end against the side of the nose, slightly below eye level. Normally, the approaching pinhead can be watched until it is about three inches away, when the eyes will be seen to diverge or the person will complain of seeing double or of being unable to continue looking at it.

**Color-Vision Tests.**—Tests for color vision should be such as not to necessitate the naming of colors. As extensive research is under way on the development of satisfactory color-vision tests, it is not possible at this time to make conclusive statements on this subject or to recommend specific types of tests. To date, the most accepted types have been those in which: (a) colors must be matched; and (b) patterns formed by colored dots must be distinguished from a background of similar colored dots. Matching tests have the disadvantage of having to be made with materials which become soiled and discolored through handling, while the pattern type may not offer true colors. Lighting is extremely important in color-vision testing, and new recommendations undoubtedly will call for a specific intensity, color, and arrangement of light.

**Depth-Perception Tests.**—When included in screening batteries, the depth-perception tests most commonly employed are those designed to be used with a stereoscopic instrument. Such a test consists of cards bearing test objects so designed that, when viewed with both eyes through the lenses of the instrument, some of the objects should appear nearer than others.

Other simple depth-perception tests which do not require such elaborate equipment are, however, available. A very gross test can be made by giving the subject and the tester each a white-headed pin with a dark shank, mounted in a dark rod about the length of a penholder. The subject faces at about arm's length a black wall against which the tester holds his pin. The test consists of ascertaining whether the subject can touch with the head of the pin he is holding the head of the pin held by the tester. This is done in the direct line of vision and in several areas of the visual field, while the head is held still and only the eyes are moved. Normally it should be possible to do this at each point. Although failure in this test indicates very little, if any, depth perception, passing the test gives no evidence of the degree of stereopsis. The test is, therefore, supplemented by another in which the person is expected to recognize the relative nearness of white-headed pins projecting varying distances from a black, octagonal-shaped board viewed from a specific distance.

While these test materials can be easily improvised to give valid results, they must be designed according to scientific principles.*†

**Stereoscopic Screening Devices.**—At present there are two instrumental batteries of tests commonly used in screening. Both of these employ test charts, to be viewed in a stereoscope (an instrument with binocular lenses), designed to discover the standard of performance of such visual functions as central visual acuity (distance and near), muscle balance, fusion, depth perception, and color vision. One of these instruments is available only to industries, and only by specific arrangements with the manufacturing concern. The other may be used by any group.

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* Davidson, Morris, M.D. A Simple Device for Measuring Stereopsis. *American Journal of Ophthalmology*, Ser. 3, 18: No. 4: 356–359: April, 1935.

† Davidson, Morris, M.D. Traumatic Ophthalmoloplegias as Workmen's Compensation Problem. *American Journal of Ophthalmology*, Ser. 3, 18: No. 11: 1030–1035: November, 1935. (For description of Perlia Test.)

Opinions vary as to the desirability of a stereoscope as an instrument for screening. Some ophthalmologists have found it satisfactory, when properly used by a well-trained technician, while others believe its use for screening is undesirable. As the findings need expert interpretation, such a device should be used only under the guidance of eye specialists.*

**Group Tests.**—Group tests owe their popularity to their economy of time. As is obvious, however, only a few of the screening procedures described can be given in a group. Even in making a Snellen test, much valuable information is bound to be overlooked in the simultaneous test of a group, since it is impossible to watch each person carefully, to see that all are fully co-operating, and to note signs of eye difficulty in reactions during the test. Further disadvantages include variations in the distances and angles at which the charts are viewed, and in the lighting in different positions in the room.

**Follow-Up of Screening.**—After the tests and observations are completed, those whose eyes seem normal should again be advised of the inconclusive nature of these procedures and urged to seek an eye examination if, at any time, they have any reason to suspect it is needed.

To those who seem to have deviations from normal, it should be explained that the screening procedures seem to suggest the presence of an eye difficulty; but that this can be determined only through a careful examination by a competent eye specialist who will also know whether treatment is needed and, if so, of what type. Because of the popular misconception that glasses are the cure-all for eye difficulties, care should be taken not to imply that they are needed.

Interpretations of the findings resulting from tests are best made in a personal interview, which allows also for correlating the advice with discussion of general health, school progress, vocational guidance, or industrial placement. It also affords opportunity for learning of attitudes, reactions, or situations which may have bearing on the matter, and for discussing arrangements for the examinations. If possible, the individual should be referred to the family physician for guidance in selecting an eye specialist. When this is not feasible, a list of eye specialists or clinics may be given and, when necessary, the person may be directed to a social agency for financial assistance.*

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* Further information on these devices and their use in schools and industries may be obtained from the National Society for the Prevention of Blindness.

When a personal interview is impossible a printed form is usually employed. This should be carefully prepared to give the desired information, without any of the undesirable implications as to certainty of the presence of an eye difficulty or its probable nature and treatment. Although the personal interview is usually more successful than the printed form in encouraging prompt action, the matter should not be considered closed even after plans are made. Many delays may occur, and further encouragement and guidance may be needed.

## Eye Examinations

A comprehensive eye examination aims to discover the condition of the eyes and related structures, the degree of visual performance, and the underlying causes of any difficulties found. An examination by a well-qualified specialist may furnish important clues to disturbances of general health.

**Scope of Eye Examination.**—A careful examination includes: family and personal history of health and of eye difficulties; inspection of external and internal structures of the eyes and of surrounding tissues; and measurement of the various aspects of visual functioning. The cornea, anterior chamber and lens may be examined with a slit-lamp and binocular microscope; and the fundus, with an ophthalmoscope which illuminates the interior of the eye, permitting a careful inspection of the retina and optic disk. Palpation may be used to determine the hardness of the eyeball but, if abnormal intraocular tension is suspected, tension may be obtained through use of an instrument called the tonometer, which is placed on the cornea (after instillation of a local anaesthetic).

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* For information on agencies assisting in such matters, apply to the National Society for the Prevention of Blindness.

The diagnosis of a refractive error is made in terms of the type and strength of lens required to neutralize the error and permit sharp focusing of the image on the retina. For this a retinoscope may be used to determine what type and strength of lens will focus its light on the retina. This objective measurement is supplemented by the use of trial lenses to find the exact correction which gives the most comfortable and satisfactory vision.

To prevent accommodation from interfering with accurate measurement of refractive errors, it is often necessary to instill a drug called a cycloplegic in the eye before making a refraction. This relaxes the ciliary muscles and dilates the pupil. As accommodation is most active in youth, a cycloplegic is used chiefly with young people. When dilation of the pupil alone is desired, the drug used is a mydriatic. After the refraction is measured, a miotic may be instilled to neutralize the effects of whichever drug has been used.

Muscle balance may be tested in various ways. Measurement of abnormalities is made with prisms, the degree and type of defect being indicated in prism diopters. Tests are also made of fusion, and sometimes of depth perception and color vision. When the need is indicated, the fields of vision may be measured with an instrument called a perimeter, or with a tangent screen; both of these provide exact information regarding the functioning in the areas of the visual field.

**Selecting an Eye Specialist.**—It is obvious that such an examination can be obtained only from a qualified eye specialist and that the care and treatment of eye conditions call for a high degree of knowledge and skill. As the term "eye specialist" may refer to anyone who specializes in any aspect of eye care, it is well to define the terms used to describe the major groups of workers in this field. They are:

> *Ophthalmologist* and *oculist* are synonomous and designate a physician who has specialized in the treatment of eye diseases and optical defects. Such a person is, of course, licensed to practice medicine and surgery in all its forms, including the prescription of glasses when indicated.
>
> *Optometrist* indicates a non-medical practitioner licensed to treat optical and muscle defects of the eyes without the use of

drugs or surgery. He may prescribe glasses and give muscle exercises. Status may be designated by the initials O.D. (for Doctor of Optometry) or the word "optometrist" after the name.

*Optician* refers to a person who grinds, fits, and supplies glasses. This involves making facial measurements, selecting and grinding lenses according to prescription, polishing and fitting them into frames, and adjusting the frames to fit the wearer.

*Orthoptist* designates a technician trained under the guidance of the American Orthoptic Council and certified by this group to give orthoptics, under the direction of an ophthalmologist.

## Long-Term Follow-Up

After the eye examination, assistance is often needed to encourage and guide the patient and family in carrying out the recommendations, and to plan and arrange for such continued help and supervision as may be indicated. Even in the simple matter of wearing glasses, people often need information regarding their correct use and the importance of periodic re-examinations and refitting of frames. Sometimes they need help in overcoming prejudice against wearing glasses.

Intelligent follow-up requires an exchange of information with the specialist and any co-operating agencies, at whatever intervals are necessary. Secondhand information received through patients, families or other laymen is seldom reliable and leads to many misunderstandings. Direct contacts with the examiner, medical social worker, or nurse on his staff, offer the best opportunity for ascertaining the nature of the problem and the advice given. Contacts such as these offer opportunity for giving return reports of progress or new developments. When personal interviews are not feasible, written reports may be substituted. Similar arrangements should be made with any community agencies co-operating in providing care.

The scope of the follow-up needed will, of course, vary with the situation, the wishes of the doctor in charge, recommendations made, and needs of the patient and family. Often, interpretations must be made to families, employers, and other interested persons as well as to patients. This is especially true in the more serious types of eye conditions and those in which care and adjustments may be needed for a long period of time. Obviously, ethical standards, the doctor's wishes, and the understanding of the person addressed, should determine what information is given. The patient's wishes must naturally be considered in interpreting his problem to others.

In conditions of long duration, frequent encouragement is often needed to keep the patient under continuous supervision by the doctor, and to help him and the family to follow recommendations and to make necessary adjustments. When home treatments are ordered, a demonstration of proper techniques by a nurse using home equipment is often the most effective means of making sure that the recommendations will be properly carried out.

While office interviews will suffice for much of this follow-up, home visits are an invaluable supplement, since they make possible an understanding of the situation and of the family attitudes and resources that can be gained in no other way. In addition, demonstrations in the home are more effective than when given in the office.

## Chapter VI.—Causes of Defective Vision and Blindness

EFFECTIVE planning for the conservation of sight and prevention of blindness requires knowledge of the scope and nature of the problems involved. This is gained through studying the prevalence and causes of blindness and defective vision and trying to learn what groups are affected.

### Definitions of Blindness, Defective Vision and Partial Sight

While the term **blindness** might easily be interpreted as a total absence of sight, certain marked restrictions of sight handicap an individual so greatly that for all practical purposes he must be considered blind. The following types and degree of visual defects are commonly recognized as constituting blindness: (a) central visual acuity of 20/200 or less in the better eye after correction; or (b) visual fields restricted to 20 degrees or less in the widest diameter, without regard to the amount of visual acuity.

Defective vision is less clearly defined, but may be considered to range from slight deviations from normal in any aspect of visual performance to such a severe loss of sight as to constitute blindness as already defined. Within this range a third classification is recognized, namely, "partial sight." This term is commonly used to indicate those with: (a) visual acuity of 20/70 to 20/200 in the better eye after correction; (b) markedly restricted visual fields, without regard to visual acuity; or (c) lesser degrees of visual impairment, but with progressive eye difficulty that is likely to cause an increasing handicap.

### Extent and Causes of Blindness

Although there is an attempt in at least one state to ascertain the total number of blind people, by making blindness reportable, there is as yet no complete register of the blind. On the basis of various surveys it is generally estimated that there are approximately two blind individuals per 1,000 of the general population, or some 260,000 blind in the entire country.

While blindness is naturally far more common among the elderly, data of the Committee on Statistics of the Blind indicate that approximately 40 per cent of the children in schools and day classes for the blind are born without sight. About half of the blindness among children in these schools and classes is of prenatal origin, of which about 13 per cent is attributed to heredity. However, neither of the latter groups of children are necessarily born blind, as the onset for some prenatal and hereditary eye conditions may be considerably delayed.*

Approximately one-fourth of the children in these schools and classes lost their sight through infectious diseases. Although ophthalmia neonatorum accounts for approximately 11 per cent in this total group, among the entering classes only 5 per cent were blinded by this disease, indicating recent progress in its prevention and control. Syphilis, mostly of prenatal origin, causes approximately 5 per cent of the blindness among these children, and meningitis, 2 per cent. Eight per cent of the children lost their sight (both eyes) from accidents, and, in a small number of cases, blindness in these children is attributable to tumors, non-infectious systemic disease, or nutritional deficiencies.

A study of these figures emphasizes the sight-saving value of adequate programs for prenatal and child care, for the prevention and control of communicable and infectious diseases, and for good safety practices.

Conditions contributing to blindness in adult life include syphilis, nephritis, diabetes, cardiovascular diseases, eye injuries and such eye diseases as cataract and glaucoma. As the causes of the two latter are not known, at present the conditions cannot be prevented, but treatment can restore sight lost through cataracts and, if begun early and adequately carried through, can prevent blindness from glaucoma.

Thus, to prevent blindness among adults the emphasis should be placed on the control of infectious diseases, especially syphilis, on eye safety, maintenance of general health, and the early discovery and proper treatment of both systemic and eye diseases.

## Amount and Causes of Defective Vision

Much less is known of the number of individuals of different ages with defective vision, or the degree and causes of such defects.

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* Kerby, C. Edith. Eye Conditions Among Pupils in Schools for the Blind in the United States, 1939–1940. *Outlook for The Blind*, 36: No. 1: 16–24: (February, 1942).

Routine screening tests in schools, industries, and among other groups are seldom sufficiently standardized or sufficiently broad in scope to provide such information.

There are a few surveys which give clues to the number of persons in specific population groups who have various degrees and types of visual defects, but which do not give underlying causes.* Thus, on the basis of a study made in 1928 of the vision of 982 preschool children, it was estimated that approximately 21 per cent had some abnormality. Of the 232 in this group examined by an ophthalmologist, 18 per cent were found to have refractive errors; 5 per cent, muscle imbalance; while smaller percentages had inflamed lids or conjunctiva, and a few, abnormalities of the eyeball.

In 1924, the United States Public Health Service reported the following data in regard to the central visual acuity among large and scattered groups of school children:

20/20 or better in both eyes in 62.9 per cent.

20/25 in one eye and 20/30 or better in the other in 27.1 per cent.

20/40 or 20/50 in one eye and 20/50 or better in the other in 6.1 per cent.

20/70 or less in one eye or both eyes in 3.9 per cent.

This and other studies from the same source indicated that:

(a) Normal visual acuity was less common in children of 6 years of age than at 16 years,† and that it was quite rare among people who had reached the age of 60.‡

(b) Over a period of two and a half years, in a group of school children, hyperopia tended to decrease both in frequency and in degree, while there was a marked increase in the frequency and progress of myopia.§

Among the candidates for induction to the military services in the second World War, defective vision has ranked second as a cause of rejection. As various minor defects and some major ones which could be corrected to approximately normal do not render the candidate ineligible for induction, defective vision may be presumed to be even more prevalent in the young male adult population than the preceding statement would indicate.

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* Mumford, Eleanor W., R.N. Digest of Problems of Vision Testing for Screening Purposes. *Sight Saving Review*, 11: No. 1: 40–53: (March, 1941), and 11: No. 2: 136–149: (June, 1941).

† Collins, S. D. The Eyesight of the School Child as Determined by the Snellen Test. *Public Health Reports*, 39: No. 48: 3013–3027. (November 28, 1924).

‡ Collins, S. D., and Britten, R. H. Variations in Eyesight at Different Ages, as Determined by the Snellen Test. Reprint No. 979, *Public Health Reports*, 39: No. 51: 3189–3194. (December 19, 1924).

§ Ciocco, Antonio. Changes in Types of Visual Refractive Errors of Children. *Public Health Reports*, 53: No. 35: 1571–1578. (September 2, 1938).

Most of the statistics on Selective Service health findings give little clue to the nature of eye defects found, but a few ophthalmological studies have been made on those failing the routine pre-induction tests. These studies show that visual defects include pathological conditions, refractive errors, amblyopia, strabismus and various degrees of color blindness. Not all of these necessitated rejection. Where corrections to approximately normal were possible, the selectees were classified as 1A and inducted into the service; others were taken in for limited service. Only those with serious and uncorrectible eye difficulties were rejected.*

Vision studies have also been extensively made in industry.

Such limited data as are available on the causes of defective vision tend to stress the presence of refractive errors and muscle imbalances. Pathology, however, while fortunately less common, is a far more significant problem in relation to defective vision, and in its early discovery, followed by prompt and adequate treatment, often lies the only chance of saving sight.†

These studies, which indicate the extent of the problem of defective vision, serve to emphasize the urgency for developing sound and effective programs for case finding and follow-up for every group. They also serve to indicate that general health protection is one of the greatest safeguards to sight and that sight conservation should be an integral part of every health program.

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* Davis, William Thornwall, M.D., and Meisenbach, A. E., Jr., M.D. Ophthalmological Findings on Draftees from the Washington, D. C. Military Area. *American Journal of Ophthalmology*, Ser. 3, 25: No. 2: 181–183: (February, 1942).

† Kuhn, Hedwig S., M.D. Appraisal of Visual Defects in Industry (Based on Study of 16,332 Cases). *Transactions of the American Academy of Ophthalmology*, 45: 208–221 (May-June, 1941).

## Chapter VII.—The Eyes in Childhood

THROUGHOUT life sight is influenced by heredity, development, mental factors, general health, eye diseases, and injuries. The eye develops from early prenatal life through young adulthood. Interferences with its normal progress, various diseases, and injuries may affect the individual's sight for the rest of his life, unless the condition can be corrected. Very often this is possible only through early care.

### Heredity and the Eyes

Studies of heredity in relation to its effect on sight indicate that the inheritance of eye structures and related mechanisms may greatly affect the individual's potentialities for either good or poor sight. While certain facts about ocular inheritance are now well established, others remain obscure because of many factors, making it impossible to determine accurately the presence of hereditary tendencies or their possible influence on future generations.

**Inheritance of Eye Color.***—Extensive studies of the variations in eye color provide a clue to the really important rôle of inheritance in the formation of the eyes and their related structures and mechanisms and to the patterns of inheritance of this particular characteristic.

As previously indicated, eye color is dependent upon the number, size, and distribution of pigmented cells in the iris and, to some extent, in the retina. While many genes influence the development of these cells, one particular or chief gene from each parent determines the results. Studies have shown genes for dark eyes to be dominant over those for all of the lighter shades. Therefore, when the chief eye-color gene from both parents is for dark eyes, the child's eyes will in all probability be dark. On the other hand, the genes for blue eyes are recessive and "true" blue eyes occur only when the chief color gene from both parents is for blue.

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* Scheinfeld, Amran, assisted by Schweitzer, Morton J. *You and Heredity.* Frederick A. Stokes Co., New York, 1939.

When the eye-color inheritance is mixed (dark from one parent and blue or some intermediary shade from the other), the child is most likely to have dark rather than light-colored eyes, the chances of blue eyes being only one in four. However, as the recessive genes are carried and passed on, "true" blue eyes may recur in some subsequent generation when these are paired with another gene for blue eyes.

These normal variations in eye color have little or no effect on ocular functioning. It is only when the pigment is deficient that vision is affected and this hereditary pattern needs consideration.

**Hereditary Ocular Defects and Diseases.**—While heredity should not be overemphasized as a cause of eye defects and diseases, it should not be overlooked. Effort should routinely be made to learn of similar eye conditions either in the direct line or in collateral members of the family group. Of course, caution should be exercised not to arouse needless fears of a hereditary eye defect.

Effects of hereditary conditions vary from slight impairment of visual function to total blindness. When the impairment is of a serious nature, the possibility of recurrence in subsequent generations needs to be carefully weighed. If the difficulty is of the dominant type of inheritance the chances of recurrence are high, but, if recessive, the risks are not so great unless both parents have the same defect. It is important to consult an ophthalmologist in regard to the possibility of passing the difficulty to the next generation. Naturally, the ophthalmologist will need all available information about ocular conditions on both sides of the family.

Developmental patterns of hereditary eye conditions show considerable variation. While the tendencies are, of course, present from the time of conception, they may not develop to the point of causing difficulty, or there may be a delayed development. Many characteristically develop at some particular age. While every attempt should be made to prevent development of a known tendency, such efforts often prove futile in the light of present knowledge. In conditions where attempts to arrest progress are equally unsuccessful, much of the treatment has to be aimed at providing such visual aids as may be needed and helping patient and family to accept the situation and make the best possible adjustment.

*Albinism.**—This is a recessive, hereditary condition, characterized by a deficiency or, rarely, a total absence of pigment in the entire body. The skin is very fair, the hair platinum-blond, and the eyebrows and lashes white. The pigment in the iris and, sometimes in the retina, is deficient or lacking, giving the eyes a pinkish appearance. Because of this deficiency of coloring matter there is extreme sensitivity to light, and many albinos are more comfortable with dark glasses. If the retinal pigment is deficient, vision is usually very poor—often there are high refractive errors, and a constant oscillating motion of the eyes, known as nystagmus. In some cases, corrective lenses may help but, in general, albinos must go through life with serious visual impairment. They need special educational and vocational advantages as well as social adjustment. Sometimes their peculiar blond appearance makes them feel conspicuous, occasionally causing untoward psychological reactions.

*Color Blindness.*—Whether partial or total, congenital color blindness is a sex-linked hereditary defect, passed through the mother (whose own color sense is seldom affected) to the sons. If, however, the mother's color vision is affected, all of her sons are likely to have the defect, but her daughters' color vision is not likely to be defective unless also inherited from the father. As already indicated, total color blindness is rare, while deficiencies—especially for red and green—are far more common. The defect, in some degree, is believed to be present in about 4 per cent of the males in this country and in about 0.4 per cent of the females.

Although this condition has little effect on total visual functioning, it is a definite handicap or even a hazard in certain occupations.

*Retinitis Pigmentosa.*†—This is a primary degeneration of the retina with a definite but varying hereditary tendency so that it may appear as a dominant, a recessive, or a sex-linked condition in any given family. Chronic and progressive, this disease is seldom evident at birth but usually manifests itself in childhood by night blindness, progressively narrowing fields of vision and, later, poor central vision. There may be temporary improvement from time to time, which raises false hopes, since some time, in midlife or later, total blindness usually ensues. Many forms of local and systemic treatment have been tried to arrest the progress, but none has proved satisfactory. However, it is often believed desirable to put considerable emphasis on nutrition, supplementary vitamins and, sometimes, liver extracts may be necessary.

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* Duke-Elder, Sir W. Stewart. *Text-Book of Ophthalmology.* C. V. Mosby Co., St. Louis, Vol. II, 1938, pp. 1398–1402.

† Duke-Elder, Sir W. Stewart. *Text-Book of Ophthalmology.* C. V. Mosby Co., St. Louis, Vol. III, 1941, pp. 2765–2782.

Because of its very serious nature, the possible social implications of the handicap resulting from retinitis pigmentosa should be given consideration.

## The Eyes in the Prenatal Period

This period is most important to the physical development of the eyes and their related structures. Starting as an outcropping of the brain, the eyes begin to develop in the early weeks of prenatal life, differentiation of eye structures commencing within the first month. As will be seen later, most of the growth takes place before birth.

**Effect of Mother's Health on Eye Development.**—The contribution of the mother's health to the health and normal development of the baby's eyes is best appreciated through the damage caused by malnutrition, metabolic disturbances, injuries, and infections of the mother during this period. All of these may cause interference with normal development, and some may lead to definite diseases of the infant's eyes either before birth or later. The earlier in pregnancy such damage occurs, the more drastic its effects are likely to be. Thus the mother's health at the time of conception and in very early pregnancy is a vital factor in giving the baby's eye development a good start and in preventing congenital defects.

**Eye Conditions of Prenatal Origin.**—In many eye conditions of prenatal origin it is impossible to determine the exact cause and sometimes, as in congenital cataract, it is difficult to differentiate between hereditary and prenatal factors unless a definite familial tendency can be established. It is, of course, much easier to establish the prenatal origin of a gonorrheal infection of a newborn baby's eyes or certain syphilitic eye conditions, whether they appear in infancy or are delayed to a later period.

*Congenital Cataracts.*—Congenital cataracts are opacities or clouding of the lens, either of hereditary or prenatal origin. They usually affect both eyes. Because of the possibility of the hereditary factor, familial tendencies should be considered in every case. Metabolic and nutritional disturbances of the mother, especially in early pregnancy, are also believed important causes. As the lens begins to develop in about the fourth week of prenatal life, the mother's health from conception on may play an important rôle.

Most of the development of congenital cataracts takes place either during the intra-uterine period, or in early childhood, and may be so minor as to cause little damage to sight at any age. On the other hand, the density may be great enough at birth to obscure vision, or may become so during the preschool or early school years, and occasionally even later. If vision is obscured at birth, or in early infancy, its fullest development depends on early surgery. Hence it is of the utmost importance to sight to find these children as soon as possible. This is best accomplished by developing an alertness to the signs of a normal development of visual interest in all infants, and prompt ophthalmological attention to any who fail to exhibit such interest. When the cataracts develop more slowly, the operations may be postponed until vision becomes sufficiently reduced to interfere with the child's normal activities.

The surgical procedures may extend over quite a period of time, each eye sometimes requiring two or more operations. As a result of the surgery, the lens becomes even more dense than before, gradually clearing as lens tissue disappears. Thus there may be a long period of even poorer vision than that to which the child is accustomed. Sometimes only one eye is operated upon at a time, surgery on the other being postponed until the first has begun to clear.

Following surgery, glasses are necessary for life, since even with surgery congenitally cataractous eyes do not have adequate focusing power. Bifocals must be used to provide for both near and distant vision.

Even when the clearing process has progressed to where glasses will be of help, visual development may take some time to reach its maximum. Approximately normal vision may be obtained (with glasses), provided the eye is otherwise normal and no complications occur.

*Prenatal Syphilis.*—Ocular syphilis in children infected during prenatal life may cause severe damage to sight, or even blindness, either at birth or at some later period. Routine examination of prospective mothers before the fifth month of pregnancy and proper treatment for those found to be infected with syphilis almost always prevent syphilitic infection of the fetus. When this procedure has been neglected or incompletely carried out, some forms of ocular syphilis may still be prevented by treatment of the infant. Once the disease has manifested itself in the eyes, it is often difficult and sometimes impossible to prevent some damage to sight.

Interstitial keratitis is one of the not uncommon delayed manifestations of prenatal syphilis, although occasionally caused by the acquired type of the disease. It occurs most frequently between the ages of 5 and 20 years. When of prenatal origin, other evidences of prenatal syphilis are usually present. Interstitial keratitis produces a deep, non-ulcerative inflammation of the cornea. The onset is sudden, with profuse tearing, pain, and extreme sensitivity to light. In the acute stage, the cornea presents a ground-glass appearance. Local treatment is combined with systemic treatment for syphilis, with attention to general health. Vision improves as the inflammation gradually subsides, sometimes leaving a clear cornea, or only a faint scar; but more often the corneal scars are permanent and may seriously affect vision. If due to acquired syphilis, the disease is usually unilateral. However, when of prenatal origin, it commonly appears first in one eye, then, some time later, in the other, even though antisyphilitic treatment was started on the first manifestation.

Optic atrophy may also result from neglected prenatal syphilis, although it may originate from many other causes affecting the nervous system. When prenatal syphilis is the cause, the condition usually becomes evident at about ten years of age. It is progressive and the prognosis is very poor, despite antisyphilitic treatment.

## The Eyes in Infancy

In studying the development and care of the infant's eyes, three major periods need consideration: at birth, the first six months, and the second six months.

**The Newborn.**—At birth a baby can see light but lacks perception of form; hence there is, at first, no attempt to fix on objects. The eyes are slightly more than two-thirds their adult size; the macula is undeveloped; the eyeballs are relatively short; the lens is spherical; the normal refractive state is hyperopic, and the two eyes do not co-ordinate. The fusion sense is believed to be normally present but undeveloped. Tears are not secreted in the early weeks. The well-known fact that the eyes are usually blue is due to incomplete development of pigment, which makes a baby's eyes sensitive to bright light. While it is important to watch for a normal reaction to light, the eyes of a newborn baby should not be subjected to extremely bright light.

Even when the baby becomes old enough for sunbaths, his eyes should be protected from the direct rays of the sun until he can move himself about easily. Placing him so that his feet are pointed away from the sun permits his brows and upper lids to shield his eyes. The hood of his carriage should be lined with dull material, preferably dark.

Blindness from ophthalmia neonatorum, which is an acute, purulent conjunctivitis of the newborn, may almost always be prevented by adequate prophylactic care of the eyes at birth and by prompt, effective treatment if symptoms occur despite prophylaxis. The infection may be either gonorrheal or non-gonorrheal. Prevention of gonorrheal ophthalmia neonatorum should start with detection and treatment of the disease in the mother during pregnancy.

The prophylactic solution which, according to many studies, seems to be the most effective for both the gonorrheal and the non-gonorrheal infection, is silver nitrate. Although Credé's original method utilized a 2 per cent solution, 1 per cent is now widely preferred and, with this, irrigation is usually considered unnecessary. Silver nitrate solution is now available in wax ampoules which many health departments provide free of charge. These ampoules protect the silver nitrate from evaporation, thus reducing the hazard of unknowingly instilling an overconcentrated solution. Their use also eliminates dangers incidental to using a medicine dropper, such as inadvertently touching the eye or chipping the tip of the dropper. The prophylactic treatment should be given as soon as possible after birth, and record made of the solution used, its strength, and the time it was instilled.

Any baby who has an inflamed or discharging eye should receive immediate medical attention. While mild irritations and tearing may be due to chemical reaction from the prophylactic solution, such symptoms may indicate the onset of ophthalmia neonatorum, in which case a delay of even a few hours in obtaining proper treatment may prove disastrous. If the disease does develop, ophthalmological and pediatric attention as well as skillful nursing care are urgently needed. Hospitalization is to be preferred to home treatment. Strict precautions are, of course, necessary to protect other patients from infection.

In the past this disease has been of several weeks' duration, frequently complicated by corneal ulcers and inflammation of the entire eye. Both eyes were often involved, even when the infection started first in one eye and every effort was made to prevent its spread to the other. With chemotherapy great progress has been made in shortening the duration of the disease from weeks to days. If treatment is instituted early enough, the development of the ulcers may be prevented.

Nursing care, nevertheless, remains extremely important, as it is necessary to keep the eyes free from pus by frequent irrigations and to maintain the child's general health. Usually in the first 24 to 48 hours, nursing service must be almost continuous. Nurses should remember the danger to their own eyes in giving necessary treatments, and safety glasses (spectacle-type goggles) should be provided for those who do not routinely wear glasses.

**First Six Months.**—The various visual functions develop at different ages, depending somewhat on the individual rate of maturation. When the baby is about ten days old his eyes begin to follow a moving light. Shortly thereafter he begins to fix momentarily on bright objects. Directing the gaze of both eyes to fix simultaneously on an object is the beginning of binocular vision, and this is first apparent at about five to six weeks of age. This co-ordination is weak at first but develops with use.

Although visual development is co-ordinated with the child's general development, in the early weeks of life the eyes take the lead. Dr. Gesell says a baby "reaches with his eyes before he does with his hand."* Reaching, touching, grasping, hearing, and seeing supplement one another. The development of co-ordination between the eyes and bodily motions, especially manipulations, is a long and complicated process.

Brightly colored wooden beads will usually attract a baby's attention almost as soon as he is able to fix his eyes on them and to bring them within his field of view by moving about. As he will also reach for them, they should be centered rather than on the side, so that he will have a free choice of the hand he uses. He will also "explore" them with his mouth; therefore, their coloring should be free from harmful substances and they should be kept clean. Such attention however, is transitory, and will only be sustained to the point of fatigue if the baby is unduly stimulated.

Some authorities recommend the use of dangling toys for infants about three to four months of age, to encourage hand and eye co-ordination, while others believe toys dangling in front of a baby's eyes are highly undesirable, encouraging too much close visual attention. There is also the danger of injury to be considered.

**From Six Months to One Year.**—During this period, hand-eye co-ordination improves gradually. The macula is usually well developed at the age of six months and, at ten months, a baby will use precise, pincerlike movements of his thumb and forefinger to try to pick up such small objects as dust particles, showing keen central vision co-ordinated with action and control of hand and finger muscles.

The use of the two eyes together continues to develop throughout these months and by the end of the first year the habit should be well established. Obviously, if the habit does not seem to be developing normally so that the baby is not rather consistently trying to fix both eyes simultaneously on an object viewed, this should be brought to the attention of an ophthalmologist.

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* Gesell, Arnold, M.D., Illig, Frances, M.D., Learned, Janet and Ames, Louise, Ph.D. *Infant and Child in the Culture of Today.* Harper Bros., New York, 1943, pp. 279–286.

## Vision of the Preschool Child*†

As the child grows the eye elongates, the lens tends to become flatter, and hyperopia diminishes in amount. Depth perception usually begins its slow development between eighteen months and three years of age. Occasionally, however, a child is born myopic or becomes so in early childhood. While myopia in slight degrees is not necessarily a handicap when it occurs very early in life, it is likely to increase with growth and development of the eye. It is therefore highly desirable to find and bring such children to ophthalmological attention as early as possible. (See Chapter V, **A Program for Early Diagnosis and Care of Eye Difficulties,** page 37.) Color vision also develops slowly; babies as young as three to six months often show a preference for red and yellow, probably being attracted by their brightness. The primary colors can usually be differentiated by a two-year-old and he may begin to use the names, correctly or incorrectly. An intelligent child with normal color vision should learn to associate colors with their correct names by about four years of age, if a reasonable effort has been made to build these associations by repeated use of proper color-names in connection with both familiar and new objects.

**Relation of Visual Development to Activities and Safety.**—Visual as well as general development needs consideration in planning for the activities and safety of a young child. Learning to observe visually, to interpret the visual impressions correctly, and to coordinate them with bodily movements, is a very gradual process. For example, the child must learn by experience to estimate distances, depth and height, and the speed of moving objects. He does not know the height of a step just by looking at it, until he has climbed up and down many times. A child may look to see if there is a car coming before he dashes out into the street, but he has little ability to estimate its nearness and the speed with which it is approaching. His safety therefore depends on protecting him from unnecessary risks until he is sufficiently mature—physiologically, visually and psychologically—to begin to assume responsibility for his own safety.

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* Rand, Winifred, Sweeny, Mary E., and Vincent, E. Lee. *Growth and Development of the Young Child.* W. B. Saunders Co., Philadelphia, 1941, pp. 30, 41, 177, 178.

† Gesell, Arnold, M.D., Illig, Frances, M.D., Learned, Janet and Ames, Louise, Ph.D. *Infant and Child in the Culture of Today.* Harper Bros., New York, 1943, pp. 25, 99, 188, 225.

Pointed or sharp objects are dangerous playthings for young children, and should be kept out of reach. A child between four and five years of age can usually be taught to use blunt scissors safely and successfully.

It is only with considerable encouragement that a preschool child can be persuaded to fix his attention on a stationary object for any length of time. Normally his primary interests are in active play. Although his sight is being constantly used, his attention is not maintained for any length of time at one point, and such play does not normally tire the eyes. In planning activities for young children, care should be taken to avoid fatigue that may result when too close attention is required. This is especially important in nursery schools.

At home or in nursery school, the preschool child needs correct light and lighting arrangements for his activities. Tables and chairs should be of appropriate size and well adjusted in order to encourage good posture. Development of desirable practices can be further encouraged by allowing the child to help in adjusting shades or lights and arranging tables in relation to the light.

The young child very much enjoys being read to, and he likes to sit beside the reader, look at the pictures, and pretend he is reading. If the book is held at the usual reading position for the reader, the child must assume a strained posture, and the book may be too close for him to see it comfortably for any period of time. Consequently he tires of it and may develop an aversion to reading. To avoid this, the child should be encouraged to hold the book where he and the reader can both see it comfortably, thus developing desirable postural habits in relation to reading.

**Visual Activities During Convalescence.**—Efforts to keep a convalescing child content sometimes result in his using his eyes for near vision for longer periods than is normal even in health.

This requires considerable expenditure of energy, and is likely to result in fatigue and irritability. It takes ingenuity to plan for activities permitting a change in visual attention, but, when he tires of nearby things, a child will rely on his distant vision for entertainment if his bed is so placed that he can look out of the window or into another room without facing the light. In selecting toys, games, and books, care should be taken to choose those which are easy to see. Attention should also be given to arranging and adjusting the light for the child's comfort. If the illness has made his eyes unusually sensitive to light, an eyeshade may be necessary or the doctor may approve his using dark glasses.

**Refractive Errors.**—The child's vision influences his interests. The fact that most young children are normally hyperopic contributes to their lack of interest in activities requiring prolonged use of near vision. In the myopic child the situation is usually reversed. Because distance vision is not clear, such a child tends to develop unusual interest in activities performed at close range, often sustaining attention on them over a longer period than is common with children of this age. He may become overly fond of picture books and want to learn to read before he is mature enough to do so. (See **Reading Readiness,** page 70.) This absorption in close work is most noticeable in the child who is very nearsighted, and, if the situation is not, or cannot be, corrected by giving the child approximately normal distance vision with glasses, it is likely to have far-reaching results.

Because of the lack of active play, musculature may not be well developed and nutrition may be poor. The poor posture, so often present, may be in part due to the tendency to bend over close work. The difference in his interests and those of most children of his age tends to isolate the myopic child so that, while he often becomes a good student, he may be a lonely child unless efforts are made to find types of activity which he can enjoy with playmates. He can usually engage safely and satisfactorily in playground and nursery school activities not requiring distant vision, such as climbing, games in which things are passed and rhythmic games and dances. (See also under **Adjustments for Partially Seeing School Children,** page 74.)

**Strabismus in Children.**—If there is unequal visual acuity in the two eyes, weakened muscles with unequal coordination of the eyes, a marked error of refraction, or a weak fusion center in the brain, a latent or manifest strabismus may result (see page 26). This squint is most likely to become obvious at about two to three years of age, but if noticed earlier, even when seen only occasionally, the child should immediately be placed under the care of an ophthalmologist.

The consensus, at present, is that for maximum results necessary treatment for strabismus (manifest or latent) should be started before the end of the sixth year—the earlier the better. Care is often required over a long period of time. Treatment may consist of correction of refractive errors, occlusion of the good eye, orthoptic training or surgery. Usually a combination of two or more forms of treatment is used. Refractive errors are sometimes corrected before two years of age.

The purpose of occlusion is to stimulate the deviating eye by covering the good eye with an occluder (patch), or opaque lens, or by instilling drugs to blur its vision. The doctor recommends the kind of occluder to be used, indicates whether the eye is to be kept covered all the time or for brief periods only, and states when he wants to see the child again. Co-operation of parents and child is essential to the success of this program and they should be impressed with the importance of periodic rechecks. As soon as the vision in the poor eye improves enough to make it possible, the child is usually given an opportunity to use the eyes together. Keeping the good eye covered too long tends to make it even more difficult for the child to develop binocular vision. The acceptance of occlusion by a child is frequently influenced by the attitude of his parents and playmates; in general, young children are less likely to be sensitive about the use of an occluder than are older children.

The aim of orthoptic exercises is to encourage the use of the deviating eye and to stimulate and develop the fusion faculty. To achieve desirable results exercises with various stereoscopic devices are carried on at regular intervals under the supervision of an orthoptist. Co-operation of both child and parent is enlisted and treatment periods may be supplemented by recommended visual activities at home.

In some cases surgery is necessary, but, on the whole, early care tends to lessen the need for operations. If surgery is needed, it contributes most effectively to single binocular vision if performed before the sixth or seventh year.

From a cosmetic and psychological point of view, deviating eyes of older children or of adults should be straightened even though single binocular vision cannot be achieved.

**Serious Eye Diseases and Defects in Preschool Period.**—Obviously the care and treatment of children suffering from serious eye defects or diseases must depend upon the nature and extent of the difficulty and the needs of the individual child. Hence, certain aspects of care and treatment are discussed in relation to particular conditions, and other aspects in relation to the education of partially seeing children (see page 74). However, it seems well here to bring together certain principles and generalizations.

Because of the extent to which visual difficulties affect a child's life, a great deal of thought should be given to providing the child with opportunities for as normal a life as possible and for preventing or minimizing psychological trauma. In some cases the prognosis may be good, and there may be prospects of reasonably normal vision, but perhaps not for some period of time. In other cases the vision will remain poor permanently or may fail gradually or rapidly. Under any of these circumstances the child has tremendous adjustments to make, either temporarily or permanently; he will need encouragement to do the things which are normal for his age in so far as is consistent with safety, his own and that of those about him—with his eye condition and with general health. Usually this involves helping him to develop interests and activities which do not rely chiefly on sight, and to learn to use his other senses to their fullest extent.

If hospital treatment and surgery are involved, the child should be prepared for this experience so that he will not be frightened, and will co-operate. If the child is old enough, suitable reassuring explanations may be given to allay fears and to encourage co-operation.

Postoperatively, this education will need to be continued and the child will need praise and encouragement for his efforts to cooperate, as well as sufficient supervision to divert his attention from the activities which are contraindicated by his condition. Gradually he can be taught what these are and be led to assume such a degree of self-direction in regard to the care of his eyes as is consistent with his maturity. The application of these principles in the care of children with eye difficulties may prevent serious complications, resulting in further damage to sight, and may lessen the possibility of psychological trauma.

**Eye Health of the School Child.**—Although the eyes reach their full size when children are about eight or nine years of age, hyperopia often persists until the late teens, even in individuals who will eventually become emmetropic or myopic. At this period of life, the power of accommodation is usually so active that a normal hyperopia should not cause strain if proper attention is given to the type and amount of close eye work undertaken and to the conditions under which the child uses his eyes. However, as tolerance varies with the general health and well-being, it is necessary to be constantly alert to signs which suggest the child is unable to do comfortably a suitable amount and type of close work. Astigmatism may also be a cause of visual discomfort as soon as the child begins to use his eyes for detailed seeing. Myopia usually has its onset during these years and interferes with the child's activities involving distant vision—both in school and in play.

**Sight and Activities of School Children.**—Throughout the school years there is an increasing use of the eyes for close work. Children also become more venturesome and play often takes a form hazardous to the eyes. Because of these facts, school and parents alike share the responsibility of providing good "seeing conditions" for all types of visual work, encouraging safe play practices, and teaching children to care for and protect their own eyes, as well as to avoid jeopardizing the sight of others through any careless or willful act. The school has a further responsibility—that of planning the educational program, giving due consideration to the visual as well as the developmental status of the children. Such program must be sufficiently flexible to permit necessary adjustments, either temporary or permanent, to be made to meet the needs of individuals.

Principles of providing adequate arrangements for using the eyes both in homes and schools have been discussed. (See **Lighting the Home, School and Industry,** page 32.) Suffice it therefore, to emphasize here the importance of using these facilities correctly, of developing desirable visual processes, and of teaching children the part these play in contributing to their visual comfort and efficiency. It should likewise be emphasized that children should be encouraged to share the responsibility, in school and at home, of adjusting lighting and seating arrangements to obtain good posture for visual work.

In the kindergarten, first and second grades, periods of close visual work should be very brief, because the children's eyes are not yet ready for much close work, and their span of attention is short. Throughout all the elementary grades, periods of close work should alternate with activities in which the eyes are used for grosser seeing or for looking at distant objects.

**Reading Readiness.**—The age at which a child is physiologically and psychologically ready to learn to read has been the subject of much discussion; most educators agree that at six and a half years the average child has the necessary degree of maturation.

Reading requires a high degree of visual skill; but learning to read is related to other factors such as social, emotional, intellectual, and physical development. These, quite as much as vision, may be the cause of individual differences in achievement in reading.

The child whose preschool experiences include picture books, stories, rhymes, and songs is more likely to be interested in reading than one who lacks such background. Sound educational methods and selection of materials suited to individual needs do much to foster a child's desire to read. Some authorities, however, believe that the first grade should be devoted to a pre-reading program to enrich the child's vocabulary and build interests in the things and ideas he will later meet in reading.*

Physical factors also play a part in the readiness to read, and there has been a tendency to blame failure on inadequate visual development or on the presence of visual defects to a greater degree than seems warranted by ophthalmological investigation. Certainly, any child who is having difficulty in learning to read should have a thorough eye examination, but other physical and psychological factors should also be investigated; the child's hearing, general health, and nutrition may influence his interest in reading.

**Eye Diseases**—As already shown, some hereditary or congenital eye diseases or defects may not be evident until some time during school life. Far more common among school children are affections of the lids and conjunctiva, minor forms of conjunctivitis being particularly frequent. As the condition may be associated with a refractive error, a cold, an infectious disease such as measles, or a nutritional deficiency, it is desirable to ascertain the cause from the family physician or the clinic doctor. If no systemic condition is found, and the eye condition persists, the child should have an eye examination. If there is any discharge, it is usually considered wise to exclude him from school until he has seen a doctor.

Blepharitis and hordeolum (stye) are commonly seen among school children and are often associated with one another. Blepharitis is a chronic inflammation of the lid margin accompanied by crusting. Hordeolum is an often-recurring inflammation beginning at the root of the eyelashes and developing at the edge of the eyelid. Since poor health, poor personal hygiene, and refractive errors may be contributory factors, a general physical examination, including an eye examination, is indicated. Attention should be given to improving the personal hygiene, nutrition, and general health.

Epidemic conjunctivitis, commonly known as "pink eye," is highly infectious and is marked by a profuse, watery discharge. In individual cases where this disease is suspected, the child should be excluded from school and precautions instituted to prevent spread of the disease. The treatment is entirely local and is aimed to relieve the discomfort and to shorten the duration of the disease.

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* Wright, Lula E. *A First Grade at Work.* Bureau of Publications, Teachers College, Columbia University, New York (1932), p. 211.

Phlyctenular conjunctivitis is an inflammation which may affect either the conjunctiva or the cornea, or both. It occurs most frequently between the ages of two and ten, and girls seem to be more susceptible than boys. The disease, the incidence of which seems fortunately to be decreasing, is characterized by blisters on the cornea or conjunctiva, photophobia, lacrimation, and blepharospasm (spasm of the eyelid). The specific cause is unknown, but the condition may be associated with tuberculosis, infection, unbalanced diet, poor personal health habits, and allergy, especially of protein origin. Refractive errors and infectious diseases such as measles may also be predisposing factors. With proper treatment, the prognosis is usually considered good.

**Finding Children Who Need Eye Care.**—In infancy and in the early preschool years, alertness to signs of eye difficulty is the principal means of discovering the need for eye care. Periodic general health examinations should include examination of the eyes. Many pediatricians use an ophthalmoscope routinely for an intraocular examination. Ideally, every child should have a thorough eye examination when he is about three or four years of age, when he enters school, and at stated intervals during his elementary and secondary school life. As this is not always possible, periodic visual screening should be done in order to facilitate the discovery of difficulties which may not otherwise be detected.

**Screening Tests and Follow-Up.***—A program of visual screening and follow-up is an important part of the preschool and the school health program, and should be carefully co-ordinated with it. The screening process includes a battery of tests designed to test the various aspects of vision. Such tests should be given in the preschool years and at least annually throughout school life. They should be supplemented by day-by-day observations by teachers of the children's visual behavior in the classroom. Such observations can provide valuable clues to the presence of visual difficulties and, when properly correlated with test findings, help in the

* Principles, policies and procedures for screening and follow-up programs are discussed on page 37.

evaluation of these. The Snellen test is widely recognized to be of major value as a part of the battery of tests and observations. The Symbol E chart is the one generally preferred, not only for preschool children, but for pupils in elementary and high schools.

Testing the vision of young children requires considerable skill and infinite patience. The Snellen Symbol E chart is usually considered preferable to picture charts, as the latter cannot be drawn to conform to the Snellen scale. Before attempting to make a test of an individual child, it is well to teach a group of children to indicate, by pointing, the direction of the shafts of the symbol. This is best done by using an "E" exactly like the largest one on the chart. This symbol is pasted on a white card. The person conducting the test turns the symbol in all directions, pausing long enough after each change to give the children an opportunity to indicate the direction in which the arms of the "E" point. For this preliminary drill the children should be only a few feet away from the symbol being shown. When they have mastered this simple procedure, they are shown the chart, which is placed at the same range. Their attention is then called to the fact that the symbols on the chart are like the one at which they have been looking, except that they are of different sizes. The children are asked to indicate the direction in which these point and are then ready to do so at a distance of 20 feet. In these preliminary procedures, both eyes are used.

Because children have a short span of attention, it is desirable to plan some other type of activity between the drill and the test, or to postpone the latter to another day. Tests should be given individually, and preferably in private. Two workers will be needed: one to sit beside the child and hold the occluding card over the eye not being tested, and the other to stand by the chart and use the window cards to expose only one symbol at a time.

While this test can, in general, be used successfully with children three or four years of age, the findings are not always conclusive on the first test. Although a visual acuity of 20/20 may be found in some young children, many will stop at the 50-, 40-, or 30-foot line. As it is not always possible to tell whether this is because of faulty vision or inability to sustain attention, it is desirable to plan a recheck in a few weeks or months, and to watch the visual behavior in the interim.

It is also desirable to include tests of muscle balance; the cover and eye rotation tests described on page 43 are suitable for this purpose. The modified Maddox's rod test described on page 44 has also been used with children of this age.

It is important that children entering school receive a test at the earliest possible moment, if their vision has not been previously tested or if the results of such tests are not known. Beginners who have not had the test will need the same kind of preliminary drill for the Snellen Symbol E test as is suggested for the preparation of preschool children. Evaluation of visual acuity findings ranging from 20/30 to 20/50 on the first test will be difficult, and the procedures previously outlined for observing the rechecking should be followed. (See page 46.)

Some schools have a policy of not referring children with visual acuity of 20/30, unless other signs of eye difficulties are observed. This seems unfortunate because, despite the teacher's opportunity to observe such signs, they may be overlooked by one who is not sufficiently versed in detecting them. Furthermore, if such test findings are accurate, the visual acuity is less than normal, and the significance of this can be learned only through an eye examination. Some schools have established what seems a safer practice, that of retesting any such cases.

Policies on follow-up vary, but most school authorities recognize the value of the personal interview with parents, either in the health office or in the child's home, using printed forms only to supplement this or when the interview cannot be arranged. It is usually recommended that parents consult their family physician for advice in selecting an eye specialist. Knowledge of the findings and recommendations of the eye specialist is essential if intelligent co-operation with him, the family, and the child, is to result. It is desirable, therefore, that the school health service or the school authorities receive a report.

**Adjustments for Partially Seeing School Children.***—Individualized planning is essential to meet the needs of those children whose vision is so defective as to interfere with ordinary activities at home, at play, and in school. As already indicated, this must take into consideration the child's ocular condition in relation to his general developmental needs. If the condition is present before he is ready for school, adjustment should not await school entry, but should be initiated as soon as serious difficulty is recognized in order to assure the best general development and protect the remaining vision. Modifications in the program are continually needed to keep pace with the child's changing needs. Planning should, therefore, be based on periodic ophthalmological and general health examinations, with necessary interpretations to those in charge of the child's care. Parents and teachers especially need help in order to understand the problems involved and to develop techniques for meeting them.

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* Hathaway, Winifred. *Education and Health of the Partially Seeing Child.* Columbia University Press, New York (1943).

Types of ocular conditions and degrees of defective vision which necessitate modification of programs are more or less an individual matter because of the variation in the ability of different children to make necessary adjustments. In schools, however, it has been found desirable to set up some general classifications of types and degrees of visual defects which are likely to make adjustment of the educational processes necessary. These classifications vary somewhat from one place to another but commonly include:

1. Using techniques suitable for educating as a blind child for those with: (a) a visual acuity of 20/200 or less in the better eye after correction; or (b) such marked restrictions of visual fields as to produce practically "tunnel vision."
2. Using techniques suitable for the education of partially seeing children for: (a) those with visual acuity of 20/70 to 20/200 in the better eye after correction; or (b) those recommended by an ophthalmologist (and in some places by optometrists) because of progressive conditions, or for temporary special consideration following an illness which has affected the eyes, or eye surgery, or during a period of ocular treatment (such as occlusion of one eye for strabismus).

While recommendations for special adjustments and the general ocular supervision are and should be the responsibility of the practitioner or eye clinic in charge of the case, schools need the services of an ophthalmologist to guide their policies and programs for these children. Recognizing their responsibility for individual adjustments, many schools have developed special classes for children needing them. While these are commonly called "sight-saving classes," many authorities believe this term gives an erroneous impression, because placement in a special class and the modification of the school program do not, in themselves, save sight. Nevertheless such classes, if properly staffed, equipped, and managed, offer many advantages; and may be an indirect means of saving sight, by encouraging proper continued supervision of the child's eye condition and his general health.

The primary purpose of such classes is to help partially seeing children to obtain the maximum benefits from their schooling and at the same time to learn to conserve their vision. To accomplish these goals, sound principles for the establishment, management and equipment of the classes are essential. Some of the widely accepted principles are:

1. In order to permit them to understand the visual problems of individual pupils, teachers should have adequate knowledge of normal and abnormal ocular functioning and be acquainted with the doctor's recommendations for each child. They should be selected for their interest in, and ability to work with, children with this type of handicap.
2. The number of children in such a class should be small enough to permit adequate attention to individual children (generally about 12 to 16 pupils per classroom).
3. Children should not be segregated. They should carry on all work requiring close use of the eyes in the specially arranged classroom under the direction of the teacher who has been prepared for this work, and should join their normally seeing companions for all other activities.
4. Children with multiple handicaps should be placed in relation to the major difficulty, the teacher having the benefit of consultation service from a colleague with special preparation in relation to the secondary difficulty. Thus, a mentally retarded child with seriously defective vision would be placed in a class for the mentally retarded, and the sight-saving class teacher would guide the teacher of the group with subnormal mentality in making necessary arrangements for his visual needs. Similarly, it is not considered desirable to place blind and partially seeing children in one class, because of the difference in the educational techniques and the amount of individual attention both groups require.

5. Classrooms should be carefully located to provide maximum service to the community, and be selected and equipped to facilitate the children's visual work and general education.

It is obvious that, if these principles are followed, such special classes offer far more advantages to these children than can be obtained through attempts to make adjustments in the regular classroom. Furthermore, teachers of such classes have great potentialities for influencing the eye health practices of the entire school, helping parents to make necessary adjustments at home, and participating in community activities relating to the education of the general public in matters pertaining to the care of the eyes.

When placement in a special class is recommended, a visit of the parents and child to the classroom is the best means of presenting its obvious advantages. Time should be allowed for them to observe the children at work, and for the teacher to interpret the program and to ascertain from the parents their understanding of and attitude toward the child's visual problem.

When for any reason a partially seeing child cannot have the benefits of a special class, every attempt should be made to apply to the general classroom programs as many as possible of the underlying principles of the sight-saving class. However, the teacher of a class of 30 to 40 children cannot be expected to carry through a program comparable to that of a teacher who has had special preparation for this work. Nevertheless, with a correct interpretation of the child's needs to school authorities and the classroom teacher, certain modifications of educational techniques can be effected and necessary facilities for the child's visual work can be provided. Such assistance may include arranging for someone to read lessons to the child; seating him where he will have the type of lighting he needs; permitting him to move about the room freely to see things; providing special books, pencils, paper, maps and other visual materials. Careful interpretation of the program should be made to members of the family and every effort should be exerted to enlist their co-operation.

## Vision and Eye Health of High School Students

Visual demands in the junior and senior high school are even greater than in the earlier years. Study periods are longer, home-work is more common and extensive, and performance in various types of vocational and physical education is often dependent on vision. Unless precautions are taken, there may also be more accident hazards.

Routine screening to determine the visual status takes on new significance in relation to vocational guidance and education. The scope of the testing should be broad enough to take into consideration the various aspects of the visual functioning, since muscle balance, depth perception, and color vision may influence a student's fitness for a given vocation quite as much as his visual acuity or his natural aptitudes. Because these students are not under the continuous supervision of one teacher, it is not possible to rely on daily observation of visual behavior. Students should be encouraged to report promptly any signs of eye difficulty, and, when giving vision screening tests, the teacher or nurse should be constantly on the alert to detect such signs. All who apparently have limitations should receive a comprehensive eye examination and, if necessary, correction or treatment. Obviously the routine screening should not in itself form the basis for vocational guidance, except for those who appear to have entirely normal visual functioning. If normal functioning cannot be obtained, the examining specialist should be asked to indicate possible types of vocations which the student may safely undertake.

Careful analysis should be made by proper school personnel of the visual demands of various processes in vocational training to determine the rôle vision will play in the student's performance. (See **Analyses of Visual Tasks,** page 81.) Hazards should also be surveyed and, as far as possible, eliminated. For grinding operations or any other type of work presenting eye hazards, students should be required to wear proper safety glasses, each student having his own. The instructors should be responsible for seeing that these are properly fitted and used, and that students learn to take proper care of them.

First aid for eye injuries should be continuously available, with adequate ophthalmological follow-up in all of the potentially serious injuries. Students should learn correct first aid procedures, with due emphasis on the importance of skilled care for even minor eye injuries.

Because of the heavy demands on vision, careful consideration should be given to lighting in study halls, libraries, workshops, laboratories, typing, and sewing rooms. It is, however, not enough merely to provide adequate lighting facilities; students must be encouraged to utilize these to the best advantage, recognizing that their maximum visual comfort and efficiency are dependent on their doing so.

### Responsibilities of Adults for the Eye Health of Children

Parents, teachers, and other adults responsible for various aspects of child care are in a key position to protect the sight of children and to teach them gradually to assume this responsibility for themselves. From earliest infancy, there should be constant alertness to visual behavior, with prompt and adequate attention to early signs of abnormality; every effort should be made to protect children's eyes from disease and injury. Here, again, it is well to bear in mind that the care and protection of the eyes should be an integral part of every child health program.

Teaching children to assume responsibility for the care and protection of their own eyes and those of others about them involves helping them to develop desirable attitudes and practices in relation to eye care. Children usually reflect those of people around them, especially parents and teachers, whose example is of the utmost importance; but it is equally important to provide children with opportunities for taking care of their own eyes through good eye health practices.

Attitudes and practices relating to treatment for eye difficulties may make the difference between success and failure of the treatment. The first step in winning the child's co-operation is to build a desire to find out, through an eye examination, whether his eyes need treatment and to develop his confidence in the doctor who will make the examination. If treatment or glasses are needed, the child must be helped to want to do his part.

Helping the child to develop correct attitudes toward a visual defect involves teaching him to recognize and utilize his potentialities to the fullest extent, and to rely on the services of experts for eye care and guidance of his activities. Sentimentality, pity, nagging, and ridicule are, of course, to be avoided at all times. The child's realization that his parents, teachers, and playmates accept him as he is helps him to learn to accept his visual difficulties and attain his fullest development.

## Chapter VIII.—Eye Health Problems in Adult Life

ALTHOUGH visual development is complete in the late adolescent or early adult years, ocular changes continue throughout life. Some of these changes are due to normal physiological and aging processes, while others are the result of disease and injury. In middle and later life, refractive errors tend to increase in prevalence and severity and ocular pathology also becomes more frequent, often resulting from systemic infections or non-infectious diseases. Some of the eye diseases of adult life are particularly characteristic of the later years.

### Vision and Activities of Adults

In the adult years, as in childhood, vision has a marked influence on interests and activities. Modern life tends to make increasing demands on the use of the eyes. Both in work and recreation, the eyes are often used over long periods for close and detailed seeing, which requires continuous use of the muscles of accommodation and convergence. Many types of work demand a high degree of depth perception. For some purposes it is necessary to watch objects, intermittently or constantly, in motion. This requires continuous visual adjustment. In many activities color and differences in shading must be perceived. Success or failure often depends on the ability to make the necessary visual perceptions quickly and easily, and to co-ordinate sight with other sensory and motor functions. The speed and facility with which the visual impressions are obtained are dependent on the functioning of the eyes and their accessory organs and on the arrangements for visual work. At best, continuous visual attention over long periods is tiring, but discomfort and fatigue are increased when an individual tries to use his eyes for types of work for which his visual efficiency is not entirely adequate, or when conditions under which he must perform the task are unfavorable. (See Chapter IV, **Making the Best Use of the Eyes.**)

## Industrial Eye Programs

Industry is showing a growing recognition of the importance of vision to workmanship and safety, through analyses of visual tasks, the development of improved programs for visual screening, general eye safety, and approved first aid procedures.

**Analyses of Visual Tasks.**—Such analyses are usually made by production and safety engineers and foremen under the guidance of visual specialists (ophthalmologists or optometrists), but the nurse in industry should be alert to the demands made on the vision of the workers. Points which she should observe include:

1. Working distance or distances.
2. Speed at which visual perceptions or visual and motor coordinations must be made.
3. Presence of distractions in the peripheral field (lights, moving objects, or other distractions which may take the visual attention off the work-point).
4. Length of periods of sustained visual attention, especially at close range or where unusual visual demands are made.
5. Effects of location of work on positions and movements of head and body.
6. Lighting, both at the work-point and in the surrounding area; its adequacy and the presence of glare and shadows.
7. Accident hazards resulting from lighting, arrangements or nature of work, or from undue fatigue.

When the experts' analysis indicates that the visual demands exceed what a worker can reasonably be expected to do efficiently, safely, and without undue strain and fatigue, attempt is usually made to correct the situation through improved arrangements. In some types of work it may be necessary to provide optical aids. An example of this is the provision of occupational glasses to enable a worker to view objects at either abnormally close range (*i.e.*, less than the standard reading distance of 12 to 14 inches) or for fine work at a greater than the normal reading distance. Such glasses are prescribed in relation both to the special job and to the visual status of the worker. Since they can be used only for a particular job, they are considered tools and as such are usually provided by the employer.

**Industrial Visual Screening and Follow-Up.**—As the subject of visual screening has been extensively discussed elsewhere (see page 37), suffice it here to point out certain applications to industry, where its primary purpose is to aid in the placement of workers in relation to their visual fitness for particular types of work.

An analysis of the visual tasks provides the basis on which to develop standards for the types and scope of visual screening tests and for the visual performance necessary to qualify for particular jobs. These standards should be set by the visual specialists guiding the analysis of visual tasks. Usually it will be found necessary to use a battery of tests designed to appraise various aspects of visual performance.

It is most important that the visual screening program should be employed in such a way as to result in the better utilization of workers, rather than their elimination because of visual defects. Few types of work require optimum visual efficiency (and many can be done satisfactorily and safely with seriously defective vision), so that if a worker is not visually qualified for one piece of work, another for which he possesses the necessary aptitudes can often be found for him.

Before this is done, however, the worker who appears to have visual limitations should have an eye examination, and effort should be made to give him the benefit of glasses or treatment to fit him for the job for which he is otherwise considered a desirable candidate. Only when this fails should an attempt be made for finding a substitute placement.

**Eye Safety in Industry.**—A national code of standards has been developed for protective equipment—both devices on machines and those worn by employees.* This code describes the essential qualities of protective devices to safeguard the worker from specific hazards. All workers should be required to wear protective glasses in occupations in which there is danger of injury from flying particles or objects, splashing metals, gases, acids or other liquids, and from harmful rays of light. In plants in which safety glasses are supplied and worn systematically, the eyes of thousands of employees have been saved. (Such protection is equally necessary when these hazards are present in work to be done at home, school, or in one's own shop.)

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* *American Standard Safety Code for the Protection of Health, Eyes, and Respiratory Organs.* National Bureau of Standards Handbook H24, Washington. U. S. Government Printing Office, Washington, D. C. (1938) 95 pp., 15 cents.

Proper selection and individual fitting of safety glasses are extremely important to the comfort of the wearer and, hence, often determine willingness to use them continuously on the job. Although commonly called "goggles," some look like ordinary, strongly built spectacles, with or without side protections. The type of frames and the need for using colored lenses must be determined in relation to the type of hazard. When necessary to reissue safety glasses, they must be sterilized and fitted to the new user. If corrective lenses or occupational glasses are required, the prescription can be ground in the safety glass, eliminating the danger and discomfort of wearing ordinary lenses under protective glasses. (Obviously, safety glasses with prescription lenses cannot be transferred to another person.)

**First Aid for Industrial Eye Injuries.**—Eye hazards are present wherever people work, and in all industries first aid programs should be carefully planned and carried out. While this service is, of course, under the direction of the plant physician or medical director, it is desirable that ophthalmological approval be obtained for the procedures and for standing orders. Adequate facilities, equipment, and training of personnel are of the utmost importance. Careful records should be kept and adequate follow-up arranged for. (For details of equipment and procedure, see Chapter IX, **Eye Safety and First Aid in Eye Emergencies**, page 87.)

## Common Eye Difficulties in Adult Life

In the earlier adult years, eye difficulties commonly seen are not unlike those found in children and are often a continuation of conditions originating in childhood. However, injuries, infections and general systemic diseases tend to be more common as a cause of ocular defects. Of the systemic diseases, diabetes, nephritis and syphilis frequently affect the eyes in various ways and may jeopardize or destroy sight if not treated in time or if their progress cannot be arrested.

**Epidemic Keratoconjunctivitis.** — Recently, widespread outbreaks of this disease, commonly known as "shipyard sore eyes," occurred in many industries and sometimes spread to homes. The disease, which is believed to be due to a virus, is not considered highly infectious, but is apparently passed by contaminated hands or articles brought into contact with the eyes. After an incubation period of from five to twelve days, the first complaint is of a "sandy" sensation or of a sensation of foreign bodies in the eye or eyes. Within a few hours edema develops; the cornea begins to take on a glassy appearance; and, shortly, corneal opacities develop. While no specific treatment has been found to affect the course of the disease to any extent, sulfa drugs are reported to ease the discomfort. The prognosis is generally good, the corneal symptoms clearing up in a few weeks; but in some cases corneal opacities remain and vision is not improved. The most important control measures lie in good personal hygiene to avoid infecting the eyes through touching them with contaminated hands, towels or other articles, and through aseptic technique practiced by all who are responsible for eye treatments. In some states the disease is reportable. Industries usually exclude infected workers, at least until the discharge has disappeared.

**Presbyopia.**—This term, which literally means "old eyes," is used to describe the condition of the eyes when the gradual decrease in the power of accommodation has progressed to the point where it is no longer possible to focus for near work. This usually begins to be noticeable in the early forties, when the person has to hold reading or other fine work at greater and greater distances in order to see it clearly. Such a person is commonly said to be "farsighted"; distance vision, however, has not improved, and near vision is no longer possible at the normal distance. Convex lenses are prescribed for near vision and, if correction is needed also for distant vision, bifocals are used, with a stronger correction in the lower segment for the near work.

Many people find it difficult to adjust to bifocal glasses, partly for psychological reasons, but chiefly because it is necessary to learn to look through the proper segments for near and distant vision. Until the person is well adjusted to the correct use of the different segments, he should be cautioned to hold on to railings when going up and down stairs and to be careful when stepping off curbs.

**Senile Cataract.**—As previously seen, cataracts may be present at birth or occur in childhood (congenital cataracts) or they may result from injury (traumatic cataracts), or from disease. The most common type, however, is senile cataract. This is characterized by a gradual clouding of the lens. It usually affects both eyes, but may develop more rapidly in one eye than in the other.

Many people greatly fear this condition. However, with skillful surgery and correct refraction, the prognosis is usually favorable, especially if the eye is otherwise healthy and the person is in good physical condition. Formerly, it was customary to wait for the cataract to be fully "ripe" before removing the lens, thus subjecting the patient to a period of virtual blindness. This is no longer considered necessary or desirable, and it is now usual to operate whenever the cataracts have developed to a point where they interfere with the patient's normal visual activities.

In the preoperative period careful attention must be given to the general health. Every effort should be made to eliminate any focal infections and to clear up systemic diseases in so far as possible. Preparing the patient and family to co-operate with the doctor and nurses during the hospital experience is also very important. With the doctor's permission, the nurse can assist by interpreting the operative and postoperative procedures, so that both patient and family understand how their co-operation will help. They should also be informed before the operation that glasses are going to be necessary for life after a cataract operation, and that if only one eye is operated upon it will not be possible to use the two eyes together, even if there is sufficient vision in the other.

**Glaucoma.**—Glaucoma may be described as a hardening of the eyeball associated with inadequate drainage of the aqueous. Since drainage is obstructed, pressure within the eye is increased. This causes a cupping of the optic nerve and impairs retinal circulation and functioning. Peripheral vision is affected first, central vision remaining good until the disease is advanced. For this reason the individual may be unaware of any disturbance until irreparable damage is done. Glaucoma usually affects both eyes. In its acute form it is very painful. In its more frequent, chronic form it is practically painless, insidious, and slow in developing. As the disease progresses, vision may be blurred or smoky, close work may be difficult despite frequent changes of glasses, halos or rainbows may appear around lights. The eye may be injected or painful, especially after the movies, in dim lights, or under emotional stress. Often these symptoms are intermittent and therefore receive little consideration. Intraocular tension may be controlled through the use of miotics; when this is not effective, surgery often is resorted to and repeated operations may be necessary. Since sight already lost cannot be restored, early discovery is most important. Continuous treatment over an indefinite period offers good hope of maintaining vision with little or no additional loss. As in any long-term disease, patients and families tend to become discouraged and to "shop around" from one practitioner to another or from clinic to clinic. Every encouragement should be given to promote continuous treatment by the same ophthalmologist or clinic. Because of the special examinations needed and the importance of follow-up, a few eye clinics have established special clinics for glaucoma patients, and these are proving their value, especially when they are adequately equipped for follow-up and for instruction of the patient and his family.

The ophthalmologist's directions must be followed explicitly. The maintenance of general health, good habits of personal health and hygiene, elimination of stimulants, and attendance at "movies" only with the permission of the eye physician may slow the progress of the disease. Since emotional stress is a definite factor, the patient should be relieved, as far as possible, of strains, tensions, and worries.

Because the onset of glaucoma is so insidious and neglect so often leads to blindness, everyone over forty years of age should have regular ophthalmological supervision, even those who have always had healthy eyes and who have no symptoms of eye trouble.

# Chapter IX.—Eye Safety, First Aid, and Follow-Up for Eye Injuries

ALTHOUGH provided by nature with remarkable protection from both injury and infection, the eyes are subject to a wide variety of hazards and are extremely vulnerable. Even a minor injury or infection, if improperly handled, may cause permanent damage to sight. While it is not possible to protect the eyes at all times from such hazards as foreign bodies and surface infections, every reasonable precaution should be taken to prevent eye injuries and to see that all emergencies are properly handled.

The most frequent types of eye injuries are those caused by flying particles or objects. The flying particles may be specks of dust which may lodge on the surface of the conjunctiva or cornea or become imbedded in these tissues. If the particles are bits of glass, steel, or other sharp substances, they may penetrate into the deeper tissues of the eyes. These are hazards which cannot always be avoided; but in all situations where they are a definite hazard (as in certain industries and in home workshops) proper precautions should be taken through the use of personal safety glasses (see page 82). It is equally important that a foreign body in the eye should be removed promptly, skillfully, and aseptically. Injuries caused by sharp or pointed objects are usually of a perforating nature and require immediate ophthalmological care.

Larger flying objects are another hazard which not uncommonly cause eye injuries. Common sources are defective tools which break easily. While the eye is well cushioned at the back, such injuries may do serious damage to eye structures.

Chemicals are also hazardous to sight; chemical burns frequently leave permanent scars on the cornea. Safeguards against chemical injuries include correct storage and handling of materials and the use of safety glasses. If injuries do occur, correct first aid and ophthalmological care are essential.

Infections of the conjunctiva and cornea may do serious damage. Precautions against these consist largely in avoidance of contaminating the eyes with soiled hands, handkerchiefs, and towels. Eyewashes are also to be avoided; the natural secretions have their own antiseptic properties which should not be routinely washed out. Some eyewashes contain drugs which may be harmful in the presence of certain eye conditions.

## Nursing Procedures for Eye Emergencies*

Many eye injuries and infections are minor in character, but are potentially serious if improperly handled. This is true even of simple foreign bodies in the eye, which are of such frequent occurrence. Injuries to the eyes are common in industries and, both here and in schools, nurses and first aiders are often called upon to take considerable responsibility for their immediate treatment. As there is often no physician close at hand, it is essential that nurses and first aiders be guided by written standing orders and, when possible, by a manual on procedures.

Any nurse or first aider who renders service in an eye injury should be: (a) thoroughly skilled in handling the eyes and in procedures to be used; and (b) competent to decide the proper course of action on the basis of the situation, the standing orders, and the individual skill.

**Standing Orders.**†—It is desirable that these be prepared by a consultant ophthalmologist in collaboration with the physician in charge, and signed by the ophthalmologist who, whenever possible, should teach the nurse all the practical procedures to be used. If first aid workers render emergency eye care in the absence of a nurse, the scope of such care should be definitely indicated in the orders, or separate orders should be prepared.

Standing orders should indicate:

1. Name, strength, and uses of all drugs and antiseptics and time they may be kept in stock.

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* Adapted from *Nursing Procedures for Eye Emergencies in Industry*, Eleanor W. Mumford, R.N.; presented at a Conference for Industrial Nursing Supervisors and Consultants preceding the Annual Meeting of the American Public Health Association, October 1 and 2, 1944, in New York City. The original outline is available in mimeographed form from the National Society for the Prevention of Blindness, and is currently used in the co-operative program for Conservation and Utilization of Eyesight in Industry.

These orders have been approved by the Chairman of the Joint Committee on Industrial Ophthalmology of the American Medical Association and the American Academy of Ophthalmology and Otolaryngology.

2. Equipment and supplies, their uses, and the techniques to be employed.
3. Specific procedures for: (a) removal of loose foreign bodies on cornea, bulbar conjunctiva or lids; and suspected abrasions; (b) imbedded and penetrating foreign bodies; (c) patient who thinks he has foreign body when none can be seen; (d) chemical, thermal, or flash burns; (e) inflammation, infection, discharge, acute eye pain, or sudden and marked changes of vision (blurring, failure of vision or double vision).
4. Scope and procedures of follow-up for major types of emergency: (a) routine instruction to patient concerning return visits and interim care, or referral to physician, clinics, or other agencies; (b) extent of care to be given in return visits; (c) rechecks of vision after eye is healed; (d) methods of securing reports from physicians to whom patients are referred.

*Equipment for Eye Care:*

1. Snellen test chart adequately illuminated (about 8 to 18 foot-candles), and distance of 20 feet.
2. 3″ x 3″ cards, conveniently placed, to use as occluders during vision test (1 clean card for each patient).
3. A focal light or pocket flashlight.
4. A magnifying lens: (a) on adjustable fixture; (b) binocular loop; or (c) a hand lens.
5. A treatment table or chair (latter without arms or with arms protected from contamination) in a separate room or corner of treatment room which can be darkened.
6. Dressing tray or table containing all supplies and used only for eye care.

*Suggested Equipment for Eye Tray or Table:**

1 white enamel dressing tray or table at least 12 inches by 19 inches.
1 pick-up forceps (pincer or sponge type) in jar of antiseptic solution.
*1 covered 4″ x 4″ glass jar containing sterile, separately wrapped, oval eye dressings.
1 covered 4″ x 4″ glass jar containing cotton wipes.
1 covered 4″ x 4″ glass jar containing sterile medicine droppers, with sterile cotton pad in bottom of jar.
1 covered 3″ x 3″ glass jar containing 2 sterile medicine glasses.
½ oz. glass-stoppered bottles (*no dropper bottles*) for all eye drugs ordered, such as staining agents, anesthetics and anti-

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* Where eye injuries are confined almost entirely to an occasional foreign body (as in schools and offices) a smaller tray may be used, and the items marked with an asterisk omitted, but in industries all of the equipment listed is likely to be needed.

septics. (If mydriatics** and miotics** are ordered, each should be in a bottle of a color or shape which will distinguish it from all the rest.) Each bottle should be plainly labeled with name and strength of drug, and label covered with scotch tape to prevent blurring.

- *1 Ziegler eyewash bottle and syringe.
- *1 covered catheter tray containing sterile asepto syringe and 1 sterile 10 c.c. luer syringe.
- *1 roll of scotch tissue or ½ inch adhesive plaster.
- *1 kidney basin.
- *3 glass- or metal-covered cups or boxes of distinctive types for ophthalmic ointments, labeled "antiseptics and anesthetics," "mydriatics," and "miotics."
- 1 magnifying lens and flashlight (unless other types of magnification and special lighting are provided).

*Care and Purchasing of Supplies:*

1. Resterilize cloth-wrapped dressings every two weeks, or prepare in quantities to be used within that time or purchase ready-sterilized in sealed, dust-proof containers.
2. Purchase drugs in small quantities, replacing as indicated in standing orders.
3. Resterilize jars and bottles before refilling.

*Preparation for Eye Care:*

1. Make patient comfortable: (a) dorsal position on treatment table; or (b) in chair with headrest (preferably without arms). If possible, Snellen test of vision should be made at this point, either before patient is placed on table or as soon as seated in chair, using small clean card to occlude uninjured eye; and findings should be recorded immediately.
2. Ask patient to close eyes *gently* and fold arms.
3. Adjust room lighting, preferably dim, for patient's comfort.
4. Adjust focal light and magnifying lens, unless pocket flashlight and hand lens are to be used, in which case they should be on tray.
5. Remove cover from tray or table.

*Aseptic Technique:*

1. Wash hands thoroughly.
2. Make careful and complete preparations before touching eye. *Once eye is handled, hands are contaminated and clean equipment must not be touched without rewashing hands.*

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* Where eye injuries are confined almost entirely to an occasional foreign body (as in schools and offices) a small tray may be used, and the items marked with an asterisk omitted, but in industries all of the equipment listed is likely to be needed.

** Mydriatics and cycloplegics are drugs which *dilate* pupils (*e.g.*, atropine); miotics *contract* pupils (*e. g.*, pilocarpine, eserine). Thus their effects are directly opposite. Instillation of a mydriatic when contraindicated may produce dire results.

A. Uncover catheter tray to serve as sterile field for dry supplies.
   (1) Using sterile pick-up forceps and re-covering each jar immediately;
      (a) Place syringes with tops extending over edge of catheter tray;
      (b) Put into catheter tray several cotton wipes, several swabs, and 2 medicine droppers;
      (c) Place 1 eye dressing and 1 medicine glass alongside catheter tray, and put 1 medicine dropper in medicine glass.

B. Place Ziegler jar and medicine bottles where they can be used during care without touching with hands. When uncovering them, turn all covers and stoppers upside down.

C. Fill medicine glass with irrigating solution.

3. Very gently cleanse lids, first with dry cotton wipe, then with moist one. *Do not dip wipe into solution*; drop solution on to wipe from dropper and squeeze fairly dry before using.
4. Inspect eye carefully: cornea, conjunctiva, upper and lower lids, everting upper lid even if foreign body is found elsewhere.
   A. To inspect cornea, retract lids, use magnifying lens and good light (preferably hand flashlight), playing beam back and forth over cornea. To inspect for a break in epithelium (if standing orders permit), instill stain, flush and reinspect for stained areas.
   B. To evert upper lid: Instruct patient to look down. Place toothpick swab horizontally across lid about ½ inch from margin. Grasp lashes, pull lid *gently* down and forward. Fold lid back over swab. Hold in place by pressing lashes with thumb against eyebrow.
   C. To return lid to normal position: Grasp lashes, pull lid *gently* forward and down, instructing patient to look up.
   D. To inspect lower lid: Retract by drawing flesh below lid margin down, pressing on orbital bone.
5. Give necessary treatment as outlined in standing orders, using first such procedures as do not require touching eye (*e.g.*, irrigation).
   A. Use all swabs only once.
   B. Moisten swabs by dripping solution on them from dropper. *Do not dip swabs into solution.*
   C. For instillation of drops into an eye, a desirable technique is to saturate a toothpick swab as outlined in *5B*, have patient look up, retract lower lid and press out a few drops of the solution by pressing swab gently but firmly

against inner rim of lower lid. A similar procedure should be used for instilling ointment.

D. If dropper is used for instillation, *use it for only one solution, and do not return dropper or excess solution to bottle or place dropper on sterile field again.*

E. Employ the utmost precautions in using mydriatics and miotics. To avoid mistakes:

(1) Place these drugs so that you cannot possibly confuse them with each other or with any other medication.

(2) Use swab procedure of instillation, pouring solution from bottle onto swab, thereby eliminating use of dropper and possible retention of one of these drugs in the dropper.

6. When treatment is completed, instruct about return or referral to doctor.
7. Wash hands, re-cover bottles, put them in proper place on tray.
8. Clean and sterilize equipment and reset tray or table.
   - A. Wash all equipment thoroughly, *removing bulbs from droppers and washing bulbs and barrels with special care.* (This is a precaution against leaving any of the solution in the dropper, which might lead to unknowingly instilling the wrong medication in another patient's eye with possibly serious results.) Put droppers together again.
   - B. Sterilize all used equipment.
   - C. Wash hands.
   - D. Return sterile equipment to proper containers, refill jars, and reset tray or table for next use. Be sure medicine droppers are dry before putting in jar.
   - E. Cover tray or table with clean cloth.
9. Complete reports of injury or other emergency, making special note for follow-up responsibilities. (A date file, indicating when patients are to return, facilitates follow-up.)

**Follow-Up.**—Follow-up consists of seven steps:

1. Instruct patient:
   - A. To report back promptly (same day if possible, next day at latest) if discomfort persists or recurs after anesthetic wears off.
   - B. Re interim care (if recommended in standing orders).
   - C. Re referral to physician, clinic or other agency for immediate care, occupational adjustment or rehabilitation.
2. Prompt referral to physician of those with continued discomfort.

3. Recheck of vision, after eye is healed, at period indicated in standing orders.
4. Secure recommendations for further nursing care, occupational adjustments or rehabilitation directly from physician.
5. In an industry or school, report all serious eye injuries promptly to the proper administrative personnel, and, in industry, assist in arranging for compensation when necessary.
6. Report any pertinent information obtained on causes of accident, including use and condition of safety equipment: (a) in an industry, to the safety director, (b) in a school, to the principal.

# Chapter X.—Opportunities for the Nurse to Teach Eye Health

NURSES have constant opportunities for teaching sight conservation and good practices relating to the care and protection of the eyes. These opportunities occur in homes, schools, clinics, health centers, hospitals, industries, or in teaching various groups. Although methods vary with the needs of individuals and groups, much of this instruction is best given in correlation with general health teaching, thus helping people to recognize the interrelationships between the normal, healthy functioning of the eyes and general health.

Frequently, such teaching is given in informal conferences in homes, schools, health centers, industries, hospitals or clinics. Often it is incidental to the rendering of nursing service. For example, when the nurse has occasion to handle a patient's glasses, she may find opportunity to give instruction about their proper care, to encourage the patient to return for an overdue eye examination, or, if she learns that the glasses have been bought over the counter without any proper examination, to guide him to proper sources for eye care. This type of teaching cannot be planned in advance; however, in many situations the nurse will, from her observations, have points in mind to discuss. She will wisely fit her instruction to the needs of the patient and will be careful to choose a time when he is likely to be receptive to it. Unless the eye problem is urgent, it may often have to await the solution of some other difficulty which seems more pressing to the patient or family. If the patient or family is not ready to give attention to an eye problem which the nurse believes so urgent that it must be given primary consideration, she must find a way to make the urgency evident. This sometimes happens when the nurse recommends an eye examination for a school child. If the child's school work is poor, discussion of the various possible contributing factors may be the best way to convince the family that possibly the child needs eye care, and that delay may be subjecting him to an unnecessary handicap.

In the eye ward, similar opportunities often exist for teaching the patient or a member of his family to carry out prescribed treatments in the home. Another function of the nurse is to interpret to the family and to visitors the patient's need for company, for lying quiet, or for other assistance, or, conversely, for encouragement again to undertake such activities as his condition permits. For example, the visitor should understand that the patient who has both eyes covered for therapeutic reasons may need to be encouraged to accept complete inactivity. On the other hand, the patient who has lost his sight permanently may need encouragement to develop wholesome independence. Visitors may need to be warned against jarring the bed of a patient who has had an eye operation or injury. If both eyes are bandaged, visitors will probably have to be told to identify themselves, as they approach the patient, to avoid confusing or startling him.

The public health nurse may contribute by preparing the patient and his family so that they will be receptive to such treatment as lying quiet, wearing glasses, or using a patch. She may also help by trying to eliminate false conceptions concerning eye treatment and by explaining why the care ordered is essential.

In the general hospital, comparable opportunities for teaching sight conservation are at hand, but frequently the nurse must stimulate interest. The nurse's attention to lighting arrangements is of particular importance to the acutely ill, and such consideration in itself has teaching value. Maternity patients are usually receptive to discussions of such subjects as an explanation of the prophylactic care of the eyes of the newborn and of the baby's visual development, care of his eyes, his first toys, and sunbaths. The mother with syphilis is likely to be interested in an explanation of need for continued treatment to protect her own and her baby's health, including sight. In the children's ward, the nurse frequently has an opportunity to suggest to parents the selection of suitable toys to bring to the children while they are in the hospital, and so to demonstrate the need for safe practices.

The questions of patients, relatives and friends open the way for many hints on eye care and sight conservation. The out-patient department of the hospital can also be utilized to teach eye health through provision of good lighting, suitable posters and exhibits, desirable reading material and diversions for children, and by answering the questions of those who come to the clinics for help in eye problems. Demonstrations of any recommended treatment are usually more effective than is word-of-mouth instruction alone.

Awareness of the fact that surgery for the removal of cataract frequently results in good sight is of tremendous significance to a patient and his family. Personal habits of the trachoma patient, and uninterrupted treatment of the syphilitic patient, need the nurse's interpretation repeatedly. The diabetic's attention may be called to the necessity for ophthalmological care in the event of eye symptoms. The family of the glaucoma patient should have frequent reminders, not only of the need for long-term ophthalmological supervision, but also of the dangers to the eyes from physical and emotional tensions. They should also be encouraged to arrange for eye examinations of other members of the family who are over 40 years of age, if this has not already been done.

In clinics, hospitals, health centers, schools, industries, and in group teaching, interest in various aspects of eye health can be stimulated by the judicious use of such visual aids as posters, exhibits and motion pictures. Pamphlets, too, can be used to good advantage, if carefully selected and directly related to the subject in hand. When a procedure is to be learned, demonstrations of how it is to be carried out and supervised practice are essential. This method is particularly important in teaching any type of treatment for the eyes, because of the dangers of unskillful handling of an eye.

In group teaching, participation of the students can be further obtained by encouraging the group to develop projects and to bring in questions relating to the specific aspects of eye health in which its members are most interested. For example, a group of young mothers might be interested in observing the activities of children in a nursing school and, in connection with this observation, some might pay particular attention to the visual behaviors of the children, while others might note work and play equipment and its significance in relation to vision and safety.

Where planned instruction is given, as in the Red Cross course in Home Hygiene and Care of the Sick, the eye teaching should be integrated at the various points at which it naturally fits in. Thus, in the discussion of the home environment, attention should be given to lighting and eye safety in the home, and, in teaching the care of infants, children, the sick, the convalescent and the aged, adequate consideration should be given to their eyes.

### Exhibits and Demonstrations

Exhibits concerned with various aspects of sight conservation and the prevention of blindness may be planned to stimulate the interest of the general public or of a particular group. For example:

> Suitable toys for children can be contrasted with unsuitable. Captions should be used to call attention to the desirability of the right type of toys in relation to ocular and general development and to their safety value.
>
> Safety glasses of various types may be displayed with labels to indicate the type of work in which they should be used. Broken or damaged safety glasses which have prevented eye injuries in schools, workshops or industries can also be shown with appropriate explanations. Pictures can be used to show a worker wearing the damaged safety glasses, with a caption saying how glad he is that he had them on at the time of the accident. Publications on particular aspects of eye health, suitable for popular use or for a certain group, may be displayed either alone or in conjunction with other related health subjects. For instance, a Child Health Day exhibit might include material on the care of children's eyes.
>
> Books for various age groups may be exhibited, but in their selection consideration should be given to the size and clearness of type, kind of paper, and other factors related to the printed page which aid in comfort and efficiency of seeing. Legends should call attention to these as items to be given consideration.

Some subjects which can be presented through demonstration include:

> Arrangements for reading in bed, with due regard to posture and lighting.
>
> Arrangement of a sickroom to provide conditions conducive to eye comfort. This should include adjustment of lighting and the provision of an eyeshade if necessary. Improvised equipment for controlling light should be utilized.
>
> The use of a light meter and rearrangement of room to obtain the correct light for each person. This can be demonstrated in office, schoolroom, factory, or any room in which a group is meeting.

First aid procedures in eye injuries, stressing need of absolute cleanliness (sterile equipment and solutions) and the need for ophthalmological follow-up when a foreign body cannot easily be removed, or in serious injuries.

The proper placement of a baby for a sunbath, showing how to protect his eyes from direct rays of the sun.

The proper care of glasses, including putting them on and taking them off, cleansing and putting them away safely. This should be supplemented by a discussion of correct examination, fitting, and adjustment.

## Projects for Special Groups

A parent-teacher association might be interested in helping develop a file showing resources for eye care, education and service to the visually handicapped, and service to the blind, including rehabilitation and vocational adjustment. Such a file can be built by finding out: (1) what agencies in the state are responsible for sight conservation, care of blind children, care of adult blind; and (2) what resources there are for provision of sight-saving classes, and for remedial services, including vocational guidance and training for children and adults with limited sight. Also, a parent-teacher association might investigate the cause and extent of eye problems in their local community through obtaining from the proper local and state agencies information concerning the number of partially seeing children, the causes of blindness in children and adults, and the number of industrial eye injuries paid for under the compensation act. Such information might lead to a community project to improve the local or state situation, either through legislation or by an extension of resources. Carefully planned observation visits are very fruitful. Planning includes selecting a date and time convenient for both the group and the agency to be visited, preparing members of the group so that they know what to look for and what questions to ask, and preparing the person or agency to give the necessary types of information to the particular group. To evaluate what has been obtained, to correct erroneous impressions, and to be most productive, such visits should be followed by a group discussion. Parents, teachers, and nurses would find much of interest in a visit to a special class for partially seeing children. They should be given an opportunity to observe the work and to discuss with the teacher the visual and educational problems of partially seeing children, the program for co-operation with regular grades, and the equipment and arrangement of the room. They will be interested to know what transportation facilities are available for children who live at a distance from the school and what arrangements are made for providing a hot lunch. In a subsequent discussion these points might be correlated with consideration of the visual screening program and the follow-up care of these children, including the arrangements for ophthalmological and general health supervision.

Where such classes are needed but are not available, community interest may be aroused through a discussion of the special adjustments necessary for visually handicapped children. An exhibit of equipment for such classes is most helpful. Some of the material used may be improvised but should conform as nearly as possible to the standard. This display should call attention to the need for ophthalmological and health supervision and for a program planned to meet individual needs.

A boy scout group might enjoy improvising equipment for visually handicapped children, such as easels, book rests, and copyholders.

A group of teachers may be interested in a study of classroom practices in relation to eye health. This might include consideration of the extent to which the schedule provides for alternating periods of near and distant visual efforts; how children are encouraged to adjust lighting to their needs; use of chalkboard facilities and visual education materials; a review of observations the teacher has made of children's behavior and appearance in relation to ocular health.

Both teachers and children like to make classroom surveys of school lighting and to experiment with making such improvements as lie within their power. A report on such a survey to the proper school authorities may result in steps for more adequate lighting where such action is needed.

A group of student nurses or a class of nurses' aides might be interested in reviewing the visual activities of convalescent children and in trying to develop some which require distant rather than near vision. In industry, the nurse will also find opportunities for working out projects with various groups. Safety campaigns are continuous in all well-organized industries. Safety centers and foremen can help in developing exhibits and demonstrations of eye safety equipment and practices, and in planning motion picture programs on this and other aspects of eye care. Projects worked out by home nursing and first aid classes can be used for display in different parts of the plant. At various group meetings the nurse can demonstrate first aid for eye injuries or, if a new vision testing procedure is to be inaugurated, this can be the subject of a demonstration and discussion.

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# INDEX

Accommodation: 21: 48
Adults:
    Common Eye Difficulties in: 83
    Eye Health Problems in: 80
    Industrial Eye Programs: 81
    Vision and Activities of: 80
Albinism: 57
Amblyopia ex Anopsia: 26
Ametropia: 22
Aqueous Chamber: 18
Artificial Lighting: (See: Lighting.)
Astigmatism: 24: (Figure V; Astigmatism; p. 24.)

Binocular Vision: (See: Vision: Binocular.)
Blepharitis, in Children: 71
Blindness:
    Causes: 51
        in Adults: 52:85
        in Children: 52: 56: 59: 60
        in Newborn: 61
    Color: 27: 57
        Tests for: 44
    Definition of: 51
    Statistics: 51

Cataract: 19
    Congenital: 59
    Senile: 85
Causes of Defective Vision and Blindness: 51
Central Vision: 21
Chiasm: 18: (Figure III; Chiasm and Optic Tract; p. 17.)
Children:
    Cataracts, Congenital: 59
    Defective Vision of: 53
    Eye Color, Inheritance of: 55
    Eye Health, Responsibilities of Adults for: 79
    Eyes in Childhood: 55
    Eyes in Infancy: 61
    Interstitial Keratitis: 60
    Opportunities for Nurse to Teach Eye Health: 94
        Exhibits and Demonstrations: 97
        Projects for Special Groups: 98
    Syphilis, Prenatal: 60
Newborn: 61
    First Six Months: 62
    Six Months to One Year: 63
Preschool:
    Eye Diseases and Defects, General Care and Treatment: 68
    Refractive Errors in: 66
    Relation to Activities and Safety: 64
    Screening Tests and Follow-Up: 27
    Strabismus in, Treatment: 67
    Vision of: 64
    Visual Activities during Convalescence: 65
    Visual Development of: 64
School: (Elementary)
    Defective Vision of:
        Adjustment for Partially Seeing: 74
        Classification of Types: 75
        Sight-Saving Classes: 76
    Eye Diseases in: 71
    Finding Children Who Need Eye Care: 72
    Reading Readiness: 70
    Sight and Activities of: 69
    Screening Tests and Follow-Up: 72
    Vision in Elementary School Years: 69
School: (High)
    Vision and Eye Health of: 77
Choroid: 15
Ciliary Body: 15

Cones: 15
Conjunctiva: 13
Conjunctivitis:
    Epidemic: 71
    Phlyctenular: 72
Cornea: 14
Color Blindness: 27: 57
    Tests: 44
Color Vision: (See: Vision: Color.)
Crystalline Lens: 18
    Cataract: 19

Dark Adaptation: 16
Depth-Perception: 25
    Tests: 44
Development:
    Conditions of Prenatal Origin: 58
    Effect of Mother's Health on: 58
    Eyes in Prenatal Period: 58

Emmetropia: 22
Epidemic Keratoconjunctivitis: 84
Examinations: 47
    Blindness, Prevention through: 37
    Children: 72
    Diagnosis and Care of Eye Conditions, Program for: 37
    Industrial: 83
    Long-Term Follow-Up: 49
    Scope of: 47
    Selecting an Eye Specialist for: 48
Extrinsic Muscles: 11: (Figure I; Extrinsic Muscles of the Eye; p. 12.)
Eye Color, Inheritance of: 55
Eye Fatigue: 35
Eye Health: 9
    and General Health: 9
    in Adults: 80
    in Children: 55
        Responsibilities of Adults for: 79
        Vision and Eye Health of High School Children: 77
    Opportunities for Nurse to Teach Eye Health: 94
        Exhibits and Demonstrations: 97
        Projects for Special Groups: 98
Eye, Prenatal Period: 58
Eye Programs in Industry: 81
Eye Safety in Industry: 82
Eye Safety, First Aid and Follow-Up for Eye Injuries: 87
Eye Specialist, Selection of: 48
Eyes, (The): 13: (Figure II; Horizontal Section—Left Eye; p. 13.)
Eyes in Childhood: 55
Eyesight Tests: (See: Vision: Screening and Screening Tests.)

Farsightedness: (See: Hyperopia.)
First Aid:
    Eye Emergencies, Nursing Procedures for: 88
    Eye Safety, First Aid and Follow-Up for Eye Injuries: 87
    Industrial Eye Injuries: 83

Glare: 28: 29: 31: 34: (See also: Lighting.)
    Reading Materials and: 36
Glasses:
    Occupational: 81: 83
    Safety: 82
    Sun: 29
Glaucoma: 85

Heredity:
    and Eyes: 55
    Eye Color, Inheritance of: 55
    Ocular Defects and Diseases: 56
        Albinism: 57
        Color Blindness: 57
        Congenital Cataracts: 59
        Retinitis Pigmentosa: 57
High School Students, Vision and Eye Health of: 77
Home, Lighting of: 32
Hyperopia: 22

Illumination: (See: Lighting.)
Industry:
  Eye Programs in: 81
  Eye Safety in: 82: 87
  First Aid for Eye Injuries: 83: 87
  Lighting in: 34
  Minimizing Fatigue through Arrangements of Work: 35
  Nursing Procedures for Eye Emergencies: 88
    Follow-Up: 92
  Visual Screening and Follow-Up: 82
  Visual Tasks, Analysis of: 81
Injuries:
  First Aid for: 83: 87
  Foreign Bodies: 87
  Nursing Procedures for: 88
    Follow-Up: 92

Keratoconjunctivitis, Epidemic: 84

Lens, Crystalline: (See: Crystalline Lens.)
Lenses:
  Corrective: 24
  Prisms: 25
Light:
  Adaptation: 16
  and the Eyes: 28
  Footcandles: 29: 34
  Measurement of: 29
  Meters: 29
  Sensitivity to: 28: 33
Lighting:
  and Room Arrangement: 29
  Arrangements: 30
  Artificial: 31: (See also: Lighting: Home; Industrial; School.)
    Direct: 31
    Fluorescent: 31
    Indirect: 31: 32: 34
    Semi-direct: 31: 32: 34
    Semi-indirect: 31: 32
  Daylight: 30: 33
  Home: 32
  Industrial: 34
  Principles: 29
  School: 33: 78
  Standards: 29: 30: 35
  Visual Comfort for the Sick: 33

Macula: 16
Making the Best Use of Our Eyes: 28
Massachusetts Vision Test: 43
Miotics: 90
Muscles:
  Balance Test for: 43: 48: 74
  Ciliary: 15: 22
  Extrinsic: 11: (Figure I; p. 12.)
Mydriatics: 90
Myopia: 23

Nearsightedness: (See: Myopia.)
Near Vision, Tests for: 43
Newborn:
  Eyes in: 61
  First Six Months: 62
  Six Months to One Year: 63
Nurses and Nursing:
  Eye Emergencies, Procedures for: 88
    Aseptic Technique: 90
    Care and Purchasing of Supplies: 90
    Equipment for Eye Care: 89
    Follow-Up: 92
    Preparation for Eye Care: 90
    Standing Orders: 88
    Suggested Equipment for Eye Tray or Table: 89
  Opportunities for Nurse to Teach Eye Health: 98
    Exhibits and Demonstrations: 97
    Projects for Special Groups: 98
Nutrition: 10

Ocular Defects and Diseases, Hereditary: 56
Ophthalmia Neonatorum: 61
Ophthalmologist and Oculist, Definition of: 48
Opportunities for Nurse to Teach Eye Health: 94

Optic Chiasm: 18: (Figure III; Chiasm & Optic Tracts; p. 17.)
Optic Disk: 16
Optic Nerve: 16
Optic Tract: 16
Optician, Definition of: 49
Optometrist, Definition of: 48
Orthoptist, Definition of: 49

Peripheral Vision: 21
Pigmentation: 14: 57
"Pinkeye": 71
Plus-Lens Test: 42
Prenatal Period:
  Effect of Mother's Health on: 58
  Eyes in: 58
  Origin of Eye Conditions: 58
    Cataracts, Congenital: 59
    Syphilis: 60
Presbyopia: 84
Preschool Child, Vision of: 64: (See also: Children: Preschool.)

Reading:
  Materials: 36
  Readiness of School Children: 70
  Visual Comfort for the Sick: 33
Refraction: 20: (Figure IV; Inverted Image; p. 21.)
  Errors:
    Accommodation of: 21
    Ametropia: 22
    Astigmatism: 24: (Figure V; Astigmatism; p. 24.)
    Corrective Lenses for: 24
    Diagnosis by Eye Examination: 48
    Hyperopia: 22
    in Preschool Child: 66
    Myopia: 23
  Normal (Emmetropic Eye): 22
Retina: 15
  Nerve Fibers of: 16
  Visual Purple: 16
  Visual Yellow: 16
Retinitis Pigmentosa: 57
Rods: 15

School Children, Vision of: 69: (See also: Children: School.)
  Elementary School: 69
  High School Students: 77
School, Lighting of: 33
Sclera: 14
"Screening," Eye Examinations, and Follow-Up: 37: (See also: Vision: Screening and Screening Tests.)
Seeing Process: 20
Senile Cataract: 85
"Shipyard Sore Eyes": 84
Sight, Organs of: 9: (Figure II; Horizontal Section—Left Eye; p. 13.)
  Partial, Definition of: 51
Sight-Saving Classes: 76: 98
Silver Nitrate: 62
Snellen Test: 40: 73
Strabismus: 26
  in Children: 67
  Latent: 26
  Manifest: 26
Squint: (See: Strabismus.)
Stereoscopic Screening Devices: 45
Stye: 71
Sunglasses: 29
Syphilis, Prenatal: 60

Tests, Vision: (See: Vision: Screening and Screening Tests.)
Tissues, Surrounding the Eyes: 10
Type, Legibility of: 36

Vascular Coat: 14
Vision:
  Binocular: 25
  Central: 21
  Color: 26
    in Children: 64
    Tests: 44
  Defective:
    Causes: 52
    Definition of: 51
    in Children: 53: (See also: Children: Defective Vision: School; Preschool; High School.)

  - Selective Service: 53
  - Statistics: 53
- Peripheral: 21
- Screening and Screening Tests: (See also: Eye Examinations.)
  - Color Vision, Tests: 44
  - Depth-Perception, Tests: 44
  - Group Tests: 46
  - Follow-Up: 46
  - Industrial: 82
- Muscle Balance, Tests: 43
  - Massachusetts Vision Test: 43
- Near Vision, Tests: 43
- Observations, Inspection and Attention to Complaints: 40
- Personnel Selection and Training, to make Tests: 38
- Plus-Lens, Tests: 42
- Preparation of Individuals to be Screened: 39
- Preschool Child: 72
- Procedures: 39
- Programs: 37
  - Preparation for: 38
- School Children: 72
  - High School Students: 78
- Snellen Test: 41: 73
- Stereoscopic Screening Devices: 45
- Types of Screening Tests: 40
- Visual Fields, Estimating Size of: 43

Visual Centers: 16
Visual Fields, Estimating Size of: 43
Visual Pathways: 18
Visual Purple: 16
Visual Screening: (See: Vision: Screening and Screening Tests.)
Visual Yellow: 16
Vitamins: 10
  - Supply of, in Retina: 16
Vitreous Body: 19

Windows, Arrangement of: 30
  - School: 33